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Graphtec Corp.
WR7600
Thermal Arraycorder

73803-028
WR7600-UM-152
Operation Manual

THERMAL ARRAYCORDER
WR7600

MANUAL NO. WR7600-UM-152

USER'S MANUAL

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Preface

The WR7600 Thermal Arraycorder was designed by Graphtec to incorporate a wide variety of advanced recording techniques, ranging from signal input to recording and data transfer.

After unpacking the recorder, read this manual thoroughly before attempting to use the recorder. Do not disassemble any part of the recorder not specifically mentioned in this manual, as this can result not only in irreparable damage to the recorder, but in bodily harm as well. Pay particular attention to the precautions described below.

Before Using this Recorder

After unpacking:

After unpacking the recorder, perform a visual inspection and a check that all required accessories have been received, making a comparison against the table in Section 1.3. If you discover a shortage or damage, contact your sales representative.

Installation

This recorder is designed to operate either horizontally or vertically in a normal indoor environment. The following adverse conditions should be avoided.

- Locations subject to excessive dust, dirt, salt and corrosive gases.
- Locations subject to temperature and humidity conditions outside the specified limits.
- Locations subject to direct sunlight.
- Locations subject to excessive vibration and shock.
- Locations susceptible to surge voltages or electromagnetic interference.
- Vertical installations in which ventilation at the bottom of the recorder is blocked.

Data Storage

Since the WR7600 uses thermochemically sensitive chart paper, the following precautions must be observed in handling data.

- Do not place recordings where they will be subjected to direct sunlight.
- Do not subject recordings to temperatures above 50°C.

- Store in a dark place if at all possible. If subjected to fluorescent or natural light for several months, recording density will deteriorate.
- Do not store inside a pouch made of vinyl chloride.
- Do not stack recordings together with wet diazo copies.
- Do not allow the recordings to come into contact with alcohols, ester ketones, or similiar agents.

Power Requirements

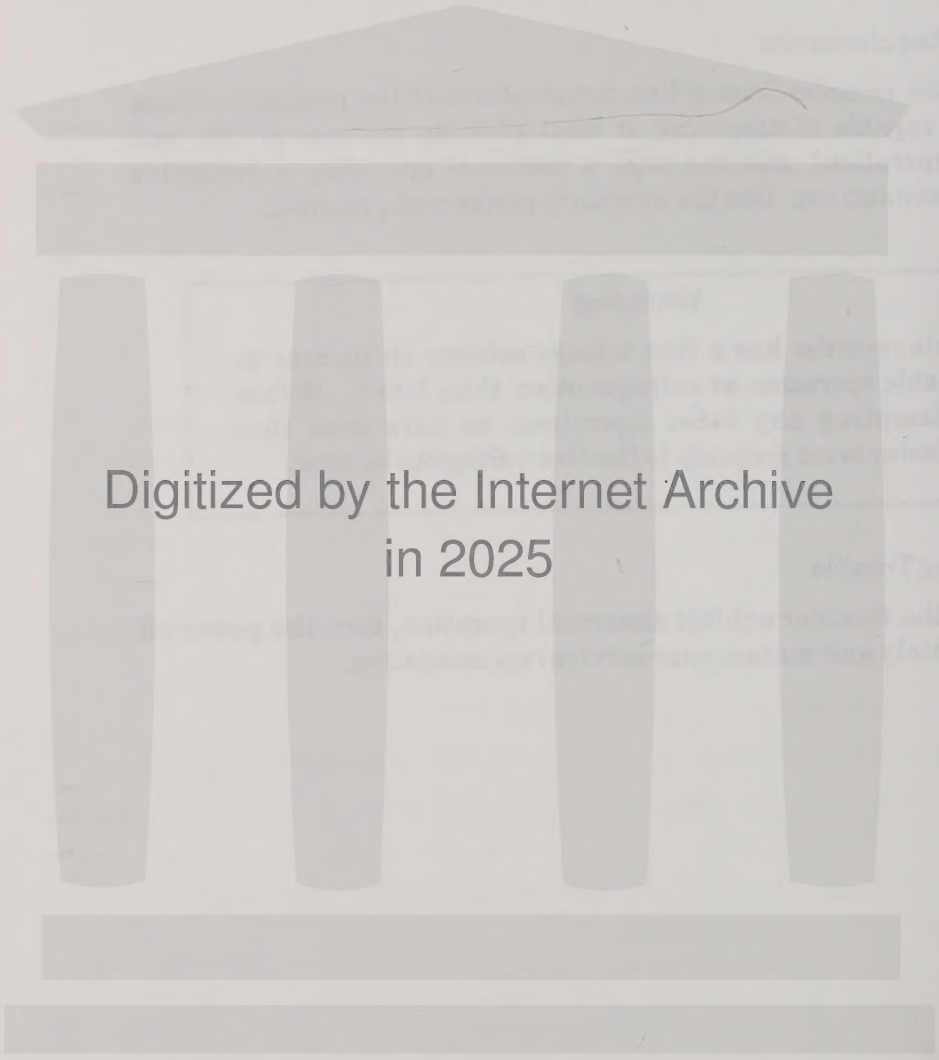
Power the recorder from a line power source of the nominal voltage ±10% capable of supplying at least 10 A (in the case of 100- and 115-V operation), and one with a means of providing a protective ground connection. Use the accessory power cord provided.

Warning

This recorder has a line voltage selector on its rear to enable operation at voltages other than 100 V. Before attempting any other operation, be sure that this selector is set properly to the line voltage to be used.

Handling Trouble

Should the recorder exhibit abnormal operation, turn the power off immediately and contact your service representative.



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1. INTRODUCTION

The section gives basic information about the WR7600, such as configuration, specifications, names of parts and menu structure.

1.1 General Description

The WR7600 is a thermal recorder capable of accommodating signal input units for up to 4 channels, and having 32 Kwords of memory per channel. It can perform continuous recording of signals from DC to 500 Hz (in the direct Y-T mode), list recording (in the direct logging mode) and recording of waveforms of signals from DC to 50 kHz which have been stored in memory (in the memory mode).

In both the direct and memory modes, a trigger can be used to start the recording and begin data recording. In addition, optional data transfer using the GPIB and memory backup are available.

1.2 Features

- Wideband Response and Large Memory Capacity

  The upper measurement frequency limit is 500 Hz in the direct mode and 50 kHz in the memory mode. The analog amplifier unit input features a floating-ground configuration and ranges from 100 mV to 500 V fs (type L), with a resolution of 8 bits.

  The memory of 32 Kwords per channel (1 word = 8 bits), easily provides sufficient capacity for most waveform-recording applications.

- Continuous Real-Time Recording

  Recording in the direct mode is performed in the same manner as with conventional recorders, with real-time recording and no time delay. In addition, the WR7600 enables the chart speed to be changed during recording.

- Multifacet Waveform Recording

  The waveform-recording format can be selected as QUAD (4 channels on 4 frames), DUAL (2 channels each overlaid on 2 frames) or SINGLE (4 channels on 1 frame), in addition to list recording in the logging mode, and analog X-Y waveform recording.

- Versatile Triggering Capabilities

  The trigger source may be selected as internal, external or manual and the memory mode can be set to pretriggering, post-triggering or normal triggering. In addition, both single and continuous operating modes are available.

  These versatile triggering functions enable a wide range of measurement and recording applications.

- Simple Condition Settings

  Settings of measurement and recording conditions are made from an interactive menu displayed on an LCD. Menu items are assigned to dedicated keys.

- High-Quality Recording

  A 6-dot/mm thermal dot array is used for thermal recording, providing not only sharp, clear recording of waveforms, but half-tone recording of scale lines, and a complete printout of measurement conditions, and scales or other added data.

  Data stored in memory can also be output after changing the recording format.

- Data Transfer (Option)

  An optional GPIB interface can be installed to enable data transfer to an external computer.

- Memory Backup (Option)

  By installing a memory backup option, data stored in memory is protected when the power is switched off. This is a convenient feature in making on-site data recording for later analysis of the data in the laboratory.

1.3 Configuration

The configuration of the WR7600 is as follows.

Table 1-1

Class	Name	Model	Qty	Remarks
Main-frame	Thermal array recorder	WR760X-XX	1	
Signal input unit	–	–	4	Analog amplifier and logic amplifier (differs depending upon configuration)
Acces-sories	Power cord		1	
	Fuse		1	3-A or 2-A slow-blow type
	Thermal recording paper	PR-230	1 roll	40 m × 110 m
	Recording paper bobbins (left and right)		1 set	
	Remote connectors		1 set	
	Screwdriver (2 mm)		1	
	Instruction manual	WR7600-UM-152	1	(This manual)
	Vinyl cover		1	
	Accessory storage bag		1	
Signal input unit acces-sories	Signal input cables	RIC-01	1/unit	Supplied with analog amplifier unit
	Logic signal input cables	RIC-10	2 sets/ unit	Supplied with logic amplifier unit

Notes

1. ×–×× Refers to the model number.
2. The DC specification mainframe (WR761×–×× or WR762×–××) comes with a power cable and fuse as described below.

Name	Quantity	Description
Power cable	1	Round 4-pin connector type
Fuse	1	10 A or 15 A

1.4 Specifications

1.4.1 General Specifications

Operating modes	Direct modes: Direct Y-T mode Direct X-Y mode Logging mode Memory modes: Memory Y-T mode Memory X-Y mode
Number of channels	4
Channel (unit) configurations	① 4 analog channels ② 3 analog + 1 logic channel (8 ch/unit) ③ 2 analog + 2 logic channels (8 ch/unit) ④ 4 logic channels (8 ch/unit) Configuration is chosen from one of ① thru ④. The logic amplifier units are installed from the lowermost numbered channels.
Memory capacity	32 Kwords/ch (1 word = 8 bits)

1.4.2 Recording Functions

(a) Recording Method

Recording method	Thermal recording (black)
Recording head	Thermal dot array (6 dots/mm)
Recording width	Approx. 106 mm (640 dots)
Signal recording width	Approx. 83 mm (500 dots) max. (Depends upon recording format)
Recording paper	PR-230 (roll paper, width: 110 mm, length: 40 m)
Recording paper feed speed	0.16 mm/4 pulses (1 mm/24 pulses)
Recording screen types	Data recording (simultaneous recording with list is possible), list recording (listing of setting conditions) and paper feed (for details, refer to subsections (b) thru (g) below.)

Recording accuracy	Y: ±0.4% of full scale ±4 dots T, X: ±5% Feed length: 40 mm/operation
(b) Direct Y-T Mode	
Recording formats	Quad, dual, single
Combinations of recorded data	Quad: 4-frame recording of CH1 thru CH4 separately from top to bottom Dual: Overlaid recording of CH1 & CH2 and CH3 and CH4 on a split (top/bottom) frame Single: Overlaid recording of CH1 thru CH4 on a single frame.
Signal recording width	Quad: Approx. 20 mm (125 dots) Dual: Approx. 41 mm (250 dots) Single: Approx. 83 mm (500 dots)
Recording paper feed speeds	1, 2, 5, 10, 20, 50 mm/min 1, 2, 5, 10, 20, 50, 100 mm/s and external syncing of feed speed (maximum of 50 mm/s) **Notes:** • For 100 mm/s feed, the signal recording is made every other pitch width. • The feed speed can be changed even after recording has begun.
Time-axis resolution	6 dots/mm
Recording length	Continuous
Interpolation function	Line recording
Sampling interval	300 Hz (with subsamples)
Frequency response	DC to 500 Hz min.
Grids	Time-axis direction: Printing of points approx. every 1 mm and half-tone lines every 5 points

	Amplitude direction: Half-tone printing of points every 5 dots and lines every 5 or 10 points
Channel numbers	Channel numbers are recorded near corresponding recorded waveforms. Channel numbers are not printed if "Print off" has been specified.
Event recording	An event signal can be input at a remote connector and recorded for each channel.
Other recorded items	Scale values for each channel (recorded divided by 5 or 10), position marks, channel numbers, event signal numbers (or logic signal numbers when a logic amp unit is used) and listings

(c) Direct X-Y Mode

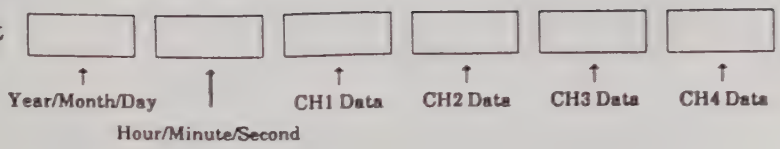
Recording width	X and Y1 thru Y3 can be assigned to any channels (or set to OFF) (See Note).
Signal recording width	For both X and Y: Approx. 83 mm (500 dots)
Recording length	Continuous
Interpolation function	Point/line, switchable
Sampling interval	Point: 5 ms Line: 15 ms
Frequency response	Point: 30 Hz (−3 dB) Line: 10 Hz (−3 dB)
Grid	Printing of points every 5 dots and half-tone lines every 10 points
Other recorded items	Scale values for each channel (recorded divided by 5 or 10), position marks, axis type, channel numbers and listings

Note

Depending upon the mainframe configuration, Y2 and Y3 settings may not be possible.

(d) Logging Mode

Recording format

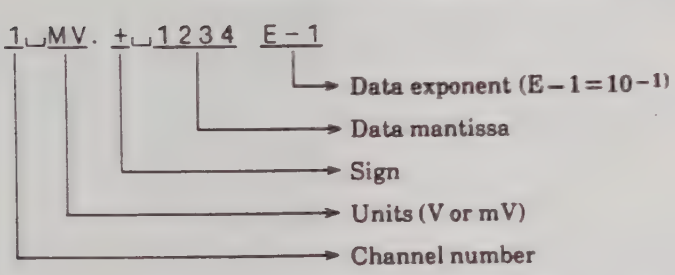


Data recorded

Year/month/day:
(Last two digits of year only)/01 to 12/01 to 31

Hour/minute/second:
00 to 23/00 to 59/00 to 59

Data for each channel:
Example for analog amp unit (for details, refer to Section 2.6.5)



Recording interval	1, 10 s, 1, 10 min
Other recorded items	Listing

(e) Memory Y-T Mode

Recording format Combinations of recorded data Signal recording width	Same as direct Y-T mode
Time-axis resolution	50, 100, 200 or 400 points/div (depends upon scaling factor setting value)
Recording time	Sampling interval memory size (number of points)
Recording length	Memory size × scaling factor ÷ 6 (mm) ((Number of points) × (1/1, 1/2, 1/4, 1/8) ÷ 6) (See Note)

Note
If the output area is specified after the memory size is set, this will be the number of points in the output area.

Recording compression function	The scaling factor (1/1, 1/2, 1/4, 1/8) is set to provide a compressed recording output.
Partial recording output	The output area is selected to provide recording output of only the desired portion of data (selectable in 4-Kword banks from 0 to 32 Kwords, but not possible for 4 Kword or less memory).
Interpolation function	Line recording
Grids	Time-axis direction: A half-tone line is printed every point and 10 points, in 5-dot units (10 points = 50 dots/div). For scaling factors of 1/2, 1/4, and 1/8, this is 100 dots/div, 200 dots/div, and 400 dots/div, respectively. Amplitude direction: A half-tone line is printed every point and 10 ten points, in 5-dot units.
Channel number	Same as memory Y-T mode
Other recorded items	Scale values for each channel (recorded divided by 5 or 10), position marks, channel number (logic signal numbers instead of the scale values for a logic amp unit), trigger marks, scaling factors and listings.

(f) Memory X-Y Mode

Axis specification Signal recording width	Same as direct X-Y mode
Recording Partial recording output	Same as memory Y-T mode
Interpolation function Grids Other recorded items	Same as direct Y-T mode

(g) List Recording

Recording types	Amplifier setting conditions for each channel (channel annotation) and all mainframe setting conditions (system annotation)

System annotation	Date, time, data no., operating mode, recording format, measurement start and stop times, trigger time, time-axis scaling, recording paper feed speed, time-axis resolution, sampling interval, trigger conditions, memory conditions, and option installation conditions (Applicable items for each mode are recorded.)
Channel annotation	Amplifier type, input ON/OFF status, range, position, filter setting condition and comments of up to 8 characters (Applicable items for the amplifier type are recorded.)

1.4.3 Memory Function (Memory Mode Only)

Sampling interval	4, 5, 10, 20, 50, 100, 200, 500 µs 1, 2, 5, 10, 20, 50, 100, 200 ms
Memory capacity	0.5, 1, 2, 4, 8, 16, 32 Kwords/ch
Memory output bank selection	Bank selection is possible in units of 4 Kwords from 0 to 32 Kwords (not possible if the memory capacity is 4 Kwords or less.)

1.4.4 Trigger Functions

Trigger source	Manual, internal, external
Trigger conditions	Manual: Triggering when MEASURE START key is pressed. Internal: Triggering on conditions set by a menu External: Triggering on a TTL low level or ground input
Trigger channel	Selectable as any channel of channels 1 thru 4
Trigger slope	Positive-going or negative-going
Trigger level	Settable from 0 to 100% in 1 % steps

For a logic amp, the trigger channel is invalid.

Trigger function	Normal, pretriggering, post-triggering	Valid only in the memory mode.
Trigger offset	12.5%, 25%, 50%, 100%	
Trigger operation	Single, continuous	
Trigger output	When the trigger is applied, an external TTL low-level pulse is output (pulse width: 200 ms)	

1.4.5 Other Functions

Operation	Mainframe: Interactive dialogue using a liquid crystal display Amplifier: Separate knobs for each channel
Comment input function	Comments of up to 8 characters may be input for each channel from the operating panel.
Clock function	Internal clock used to record and display date and time.
Battery backup function	An internal battery is provided as a backup for the clock and all operating mode setting conditions (approx. 1 month on a full charge).
Power-on start function	The operating conditions in effect when power is removed are restarted when power is applied once again.
Reprint function	Data captured in the direct X-Y and memory modes can be reprinted, even after changing the recording format.
Remote function	An external clock can be used to sync recording paper feed, switch the remote and local statuses and start and stop recording.

1.4.6 General Specifications

Operating environment	0 to 40°C, 35 to 85% humidity
Power requirements	AC: 100 VAC ±10%, 50/60 Hz (115, 200, 220 or 240 VAC also selectable) DC: +12 VDC or +24 VDC
Power consumption	90 VA max.
Weight	Approx. 7.5 kg
Outer dimensions	Approx. 350×120×161 mm

1.5 Front Panel Description

1.5.1 Front Panel Layout

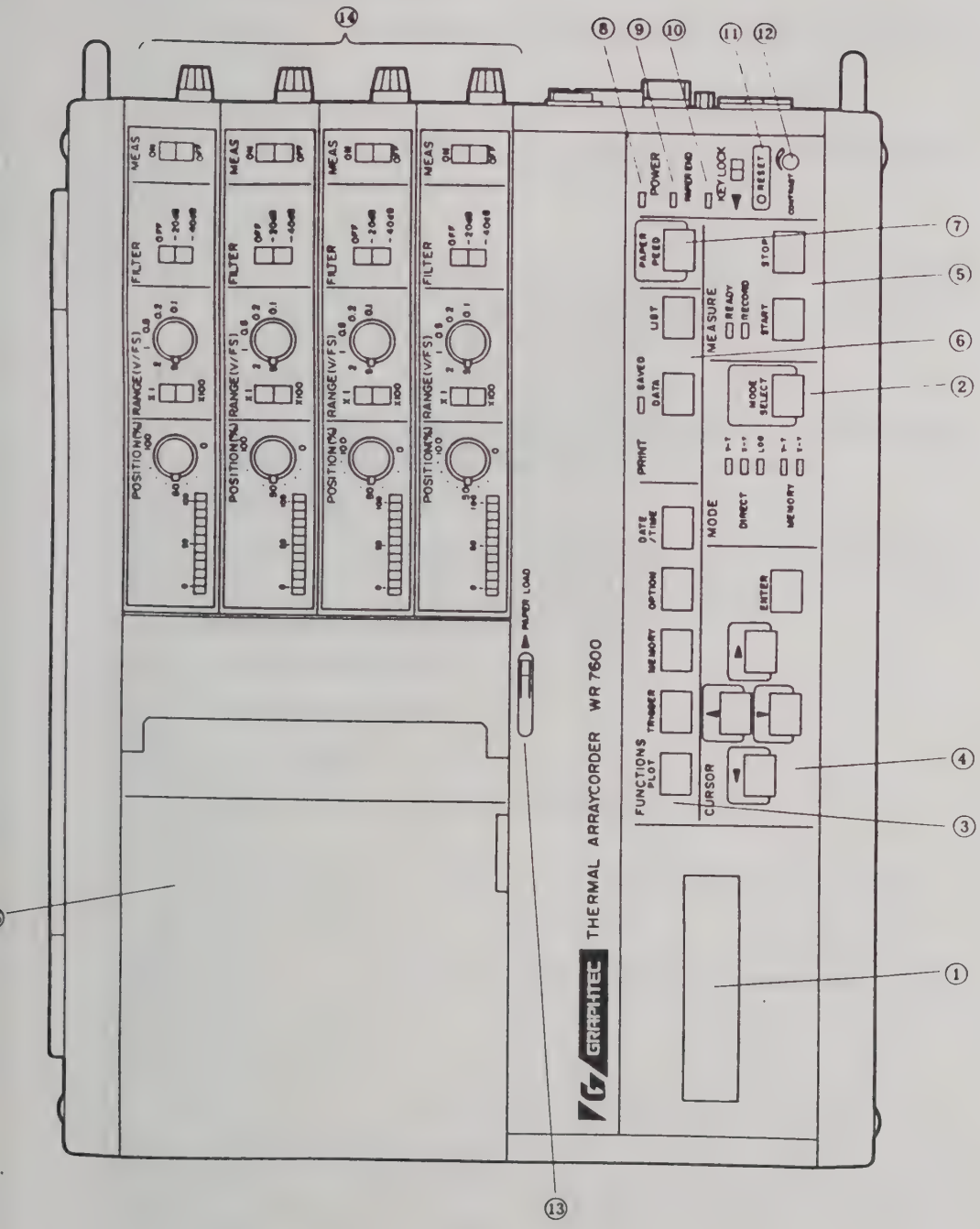


Fig. 1-1

① LCD

Liquid crystal display used to display menus for operating condition settings and display of operational status.

② MODE SELECT key

Used with its associated LED to select and indicate the operating mode.

③ FUNCTIONS key group

Used to make memory selections for operating conditions and other settings within each operating mode.

④ CURSOR key group

Consists of the cursor keys used to make selections of both setting values from each menu and menu items and the ENTER key used to enter the selection.

⑤ MEASURE key group

Consists of the measurement START and STOP keys and LEDs which indicate the current measurement condition.

⑥ PRINT key group

Consists of the LIST key used to output setting conditions for each operating mode, the DATA key used to output data from memory, and the associated display LEDs.

⑦ PAPER FEED key

Feeds blank paper.

⑧ POWER LED

LED lights green when power is applied.

⑨ PAPER END LED

LED lights red to warn that the paper end has been reached.

⑩ KEY LOCK

Key switch to prevent accidental human misoperation and its associated LED.

⑪ RESET switch

Places the WR7600 in the fully initialized condition.

CONTRAST adjustment

⑫ Trimmer adjustment used to adjust the contrast of the LCD. Turning it to the right increases the contrast.

⑬ PAPER LOADING lever

Used to install recording paper.

⑭ Amplifiers

Measurement amplifiers for each channel.

⑮ Recording panel

Opens and closes for paper loading

1.5.2 MODE SELECT Key

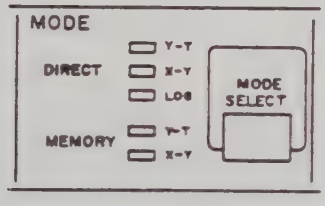


Fig. 1-2

This is the mode selection key. Each time it is pressed, the operating mode changes, with the LED corresponding to the mode lighting. (Impossible-to-set modes are automatically skipped.)

1.5.3 FUNCTIONS Key Group

These keys are only operable in the STOP condition.

Note

The STOP condition is when:

- MEASURE is set to READY and the RECORD LED is extinguished.
- the recording operation is stopped.
- the KEY LOCK LED is extinguished.

(Details of the function menus for each mode are described elsewhere.)

(1) PLOT Key

Selects the recording format setting menu.

(2) TRIGGER Key

Selects the trigger condition setting menu.

(3) MEMORY Key

Activates memory measurement.

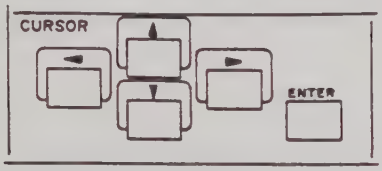
(4) OPTION Key

Selects the option menu.

(5) DATE/TIME Key

Reads the date and time, and selects the date and time setting menu.

1.5.4 CURSOR Key Group



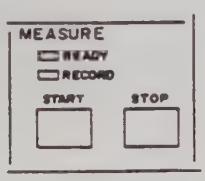
(1) CURSOR Keys

Operative in the STOP condition. Used to select menu items from each menu, to select setting values, and to increment and decrement values. The left and right keys are also operative in the direct Y-T START condition.

(2) ENTER Key

Operative in the STOP condition. Used to change menu items and to make setting values.

1.5.5 MEASURE Key Group



(1) START Key

Operative in the STOP condition only, pressed to start measurement. When this key is pressed, the START condition is enabled and the READY LED lights.

(2) STOP Key

Operative only in the START condition, pressed to stop measurement. When this key is pressed, the measurement is immediately stopped and, after the required post-processing, the STOP condition is enabled.

(3) READY LED

This LED lights when the START condition is enabled and the recorder is in the trigger wait condition. It is extinguished when the trigger is actually input.

(4) RECORD LED

This LED lights when the trigger is input and the actual measurement is in progress. When the measurement is completed, after all post-processing is finished, the LED is extinguished.

Note

The START condition is the condition in which the MEASURE READY LED or RECORD LED is lighted.

1.5.6 PRINT Key Group

These keys are only operative in the STOP condition.

(1) SAVED LED

Lights when data which can be printed out has been stored in memory. When lit, changes in recording format output are possible.

(2) DATA Key

If this key is pressed when the SAVED LED is lighted, it is possible to output a recording of data stored in memory. However, if the operating mode is changed after data is stored in memory, the key may become inoperative, depending upon the newly set operating mode.

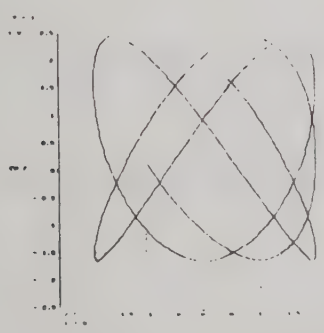


Fig. 1-3

(3) LIST Key

Outputs in list form the setting conditions of the mainframe and amplifiers.

Fig. 1-4

1.5.7 PAPER FEED Key

Operative only in the STOP condition. Each time it is pressed, the recording paper is fed approximately 40 mm.

1.5.8 KEY LOCK Switch

Operative only in the STOP condition. When slid in the direction of the arrow, the keys are locked (the associated LED will light), and all front-panel keys will become inoperative. (This does not include, however, operating switches of the amplifiers and the TTL remote or GPIB remote control functions.) During a recording operation, the key lock condition will be enabled only after the current recording operation is completed.

1.5.9 RESET Switch

Operative only in the STOP condition, places the WR7600 setting values in the initialized conditions.

This switch can be operated by depressing it with a pin or similar instrument having a diameter of approximately 1 mm.

1.6 Side Panel Description

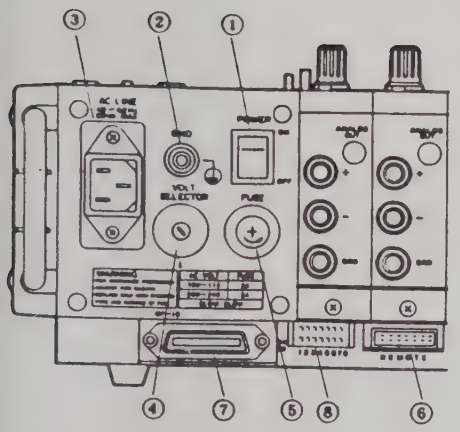


Fig. 1-5

① POWER switch

Recorder power switch.

② GND terminal

Ground terminal which is connected to the case. It should be connected to a separate ground when the recorder is used with a power plug not having a protective ground terminal.

③ AC LINE receptacle

This receptacle is used to apply AC line power using the power cord (with its protective ground terminal).

④ VOLTAGE SELECTOR

Used to set the AC line voltage. A flatblade screwdriver should be used to align the bar at the center to the desired line voltage.

⑤ FUSE Holder

Contains a protective fuse which prevents circuit damage should an overcurrent condition occur. Turning the cap in the direction of the arrow enables removal and replacement of the fuse.

Precautions

1. When replacing the fuse, always remove the power cord from its outlet first.
2. When replacing the fuse, be sure to use a fuse of the rating listed in Table 1-1. Never attempt to repair a fuse or to use a fuse of a different rating.
3. Before connecting the WR7600 to the power line for the first time, make absolutely certain that the VOLTAGE SELECTOR is set to the proper line voltage.

⑥ EVENT Input (Remote) Connector

Used to input event recording signals and remote signals. Its pin arrangement is shown in Fig. 1-6. In making connections to these signals, use the mating accessory connector provided.

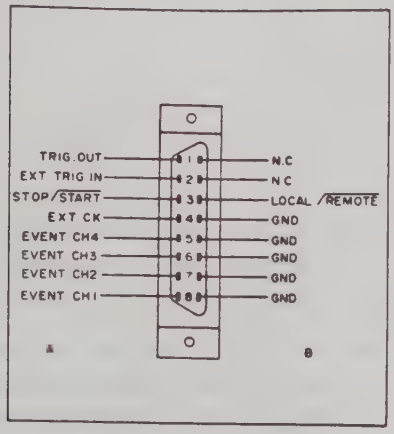


Fig. 1-6

Note: Do not make external signal connections to pins marked NC.

- $\overline{\text{EVENT CH1 Thru CH4}}$ Pins

  Apply a TTL low-level signal to these pins or short the pins to ground to perform event recording on the corresponding channels.

- EXT. CK Pin

  Clock input pin for external syncing of paper feed. With external syncing of paper feed speed, the paper can be fed at a speed of up to 50 mm/s. A TTL level signal in the range 0 to 1200 pps should be input (1 pitch/4 pulses, 1 mm/24 pulses).

- STOP/$\overline{\text{START}}$ Pin

  A signal can be input at this pin to perform the same operations as the front-panel MEASURE START and STOP keys. This pin is only operative, however, when the LOCAL/$\overline{\text{REMOTE}}$ pin is in the $\overline{\text{REMOTE}}$ condition.

STOP	TTL level-high input or pin left open
$\overline{\text{START}}$	TTL level-low input or pin shorted to ground

- $\overline{\text{EXT. TRIG. IN}}$ Pin

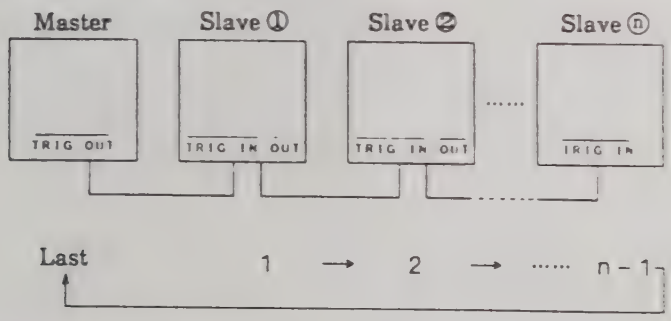
  External trigger input pin. Triggering occurs when a TTL low-level signal is input to this pin or when the pin is shorted to ground (GND).

- $\overline{\text{TRIG. OUT}}$ Pin

  This pin outputs a signal when the trigger is applied. A TTL-level low pulse having a width of approximately 200 ms is output. This output function can be used to synchronize several WR7600's for simultaneous recording.

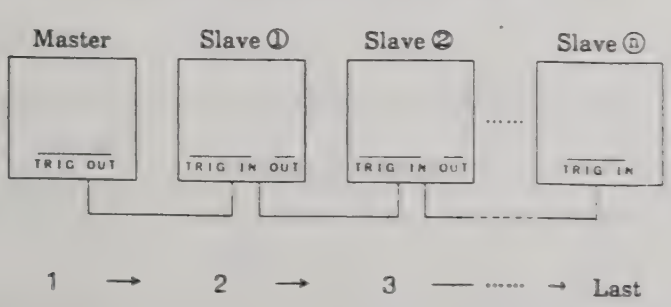
- When using the $\overline{\text{EXT. TRIG. IN}}$ and $\overline{\text{TRIG. OUT}}$ pins for synced operation, take care with the following.

Ⓐ When using the master recorder in the manual triggering mode, set the slave recorder into the external triggering mode and start the recorders in the sequence starting at the recorder closest to the master recorder. Then start the master recorder itself.



MEAS START sequence

Ⓑ When using the master recorder in the external or internal triggering mode, start the master recorder first, and then start the slave recorders in a sequence which starts from the recorder closest to the master.



MEAS START sequence

- LOCAL/$\overline{\text{REMOTE}}$ Pin

  Establishes whether the measurement start and stop functions are to be performed from the front-panel MEASURE START and STOP keys or from the above-mentioned remote input. When set to LOCAL, the operating panel START and STOP keys are operative and the signal conditions on the remote pin will be ignored. When set to $\overline{\text{REMOTE}}$, only the remote pin is operative and the panel START and STOP keys are ignored. (GPIB control is always operative, regardless of this function setting.) When the status of the signal on this pin changes, the LCD initialized display will indicate the status as either LOCAL or REMOTE. (When a change in LOCAL/$\overline{\text{REMOTE}}$ is made when the recorder is in the START condition or when paper is feeding or printing is in progress, the change will be made only after that operation is completed.) (See Fig. 1-7 and 1-8)

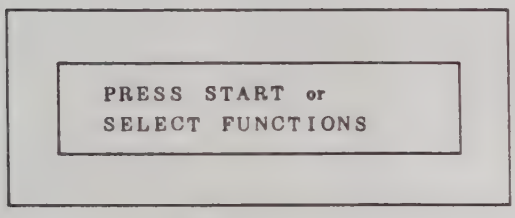


Fig. 1-7 Initialized Display for the LOCAL condition

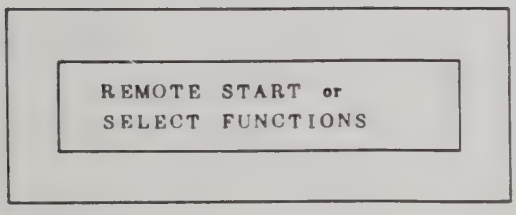


Fig. 1-8 Initialized Display for the REMOTE condition

LOCAL	TTL level high input or pin left open
$\overline{\text{REMOTE}}$	TTL level low input or pin shorted to GND

⑦ GPIB Connector

⑧ GPIB Setting Switches

} Refer to the GPIB/Backup Option User's Manual.

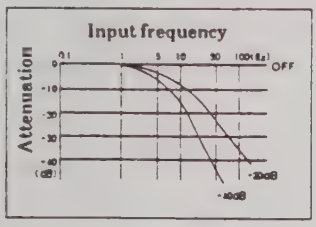
1.7 Unit Specifications and Functions

This section describes the specifications and functions of units that can be installed in this recorder. The unit configuration is determined at the time the recorder is ordered and cannot, generally, be changed after delivery.

1.7.1 Analog Amp Unit (L Type)

(a) Specifications

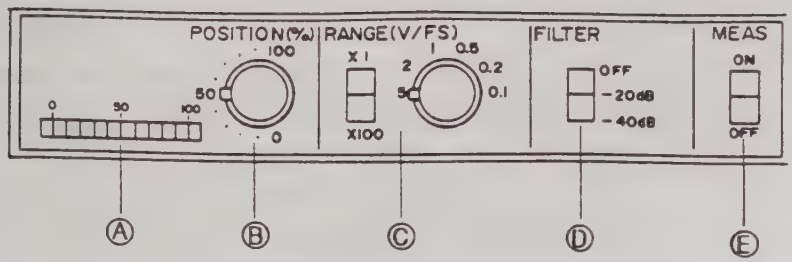
Number of channels	1
Input configuration	Floating ground with guard
Input ranges	0.1, 0.2, 0.5, 1, 2, 5, ×1, ×100 V/fs
Input filter	Purpose: Elimination of unwanted high-frequency components Rolloff at 50 Hz: 0, −20, −40 dB



Filter characteristics

Maximum allowable input voltage	Between (+) and (−) terminals: 500 V Between terminals and guard: 500 VDC, 170 VAC rms
Input impedance	1 MΩ (signal source resistance: 1 kΩ max.)
Frequency response	DC to 100 kHz (at −3 dB) (with an input filter rolloff of 0)
Zero-point adjustment	Settable in 10% steps within the full-scale range
Input waveform monitor	12-dot LED monitor of the input signal

(b) Functions



Ⓐ Monitor LED Display

This LED display provides a monitoring of the signal waveform. All LEDs light for the (+) over-scale condition and all LEDs are extinguished for the (−) over-scale condition.

Ⓑ POSITION (%) Adjustment

Zero-point adjustment. The zero point can be adjusted over the full-scale range in 10% steps.

Ⓒ RANGE (V/FS) Switch

Includes the range switch and the multiplier settings, with which the amplifier range (full-scale value) is established.

Ⓓ FILTER Switch

Input filter switch. It should be set to eliminate high-frequency noise.

Ⓔ MEAS ON/OFF Switch

When this switch is set to OFF, the input is separated from the recorder and the output becomes 0 volts. It is set to ON for normal measurements. In addition, if the OFF setting was made before the mainframe MEASURE START key is pressed, it operates as a PRINT OFF function (eliminating the recorded trace). (Refer to Section 2.4.5 ④.)

1.7.2 Logic Amp Unit

(a) Specifications

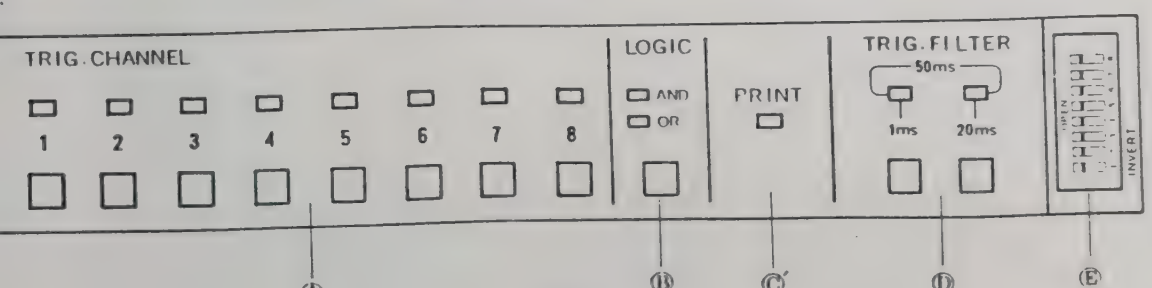
Number of channels	4×2
Input configuration	Common ground within each unit, floating case
Input signals	TTL-level input Contact input short or open
Response time	4 μs
Trigger	Trigger-source channel is switch selected. Trigger conditions consist of AND or OR of the valid channels.
Trigger filter	A filter is provided to remove chattering from the trigger signal. Time constants selectable as 0 (off), 1, 20, or 50 ms.
Signal inversion	Each input channel is independently invertible (by DIP switch settings).
Print ON/OFF	Set by means of the record ON/OFF switch

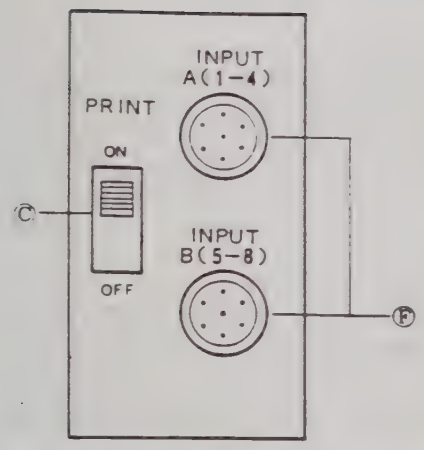
(b) Functions

Ⓐ **Trigger Channel Setting Switches:** Used to set the valid trigger channels. When a switch is pressed, the corresponding channel becomes valid and the associated LED lights. Pressing the switch once again makes the channel invalid and extinguishes the associated LED.

Ⓑ **Trigger Condition Setting Switches:** Used to set the trigger conditions. These conditions combine the signals for the channels selected by switches Ⓐ, and can be the AND or the OR of these signals (trigger is positive logic).

Ⓒ **PRINT ON/OFF Switch:** Turns the signal recording on and off. When set to OFF, none of the signals input to the unit are recorded. When set to ON, signals are recorded and the LED Ⓒ' lights.





Ⓓ **TRIG FILTER Switches:** Used to set the time constant of the anti-chattering filter which removes chatter from the trigger signals. Combination of these two switches are used to set the following time constants.

Time Constant	Switch Settings
0 (OFF)	⊓ ⊓
1 ms	⌐ ⊓
20 ms	⊓ ⌐
50 ms	⌐ ⌐

Ⓔ **INVERT Switches:** These DIP switches are used to invert individual input signals. When a switch is set to the OPEN position, the corresponding signal is not inverted.

Ⓕ **Logic Signal Input Connectors:** These are the signal input connectors. Two connectors, A and B, are provided, with A used to input signals for channels 1 thru 4, and B used to input signals for channels 5 thru 8.

Note

The trigger is set by combinations of Ⓐ, Ⓑ, and Ⓔ. Trigger conditions use positive logic.

1.8 Menu Configuration and Selection Procedure

Settings of measurement conditions can be separated into those items set at the amplifier and those set from a menu. Ampliifier settings are made in much the same manner as with other analog recorders.

As described in the specifications section of this manual, the WR7600 has a large number of processing functions. Menu settings are used to select just the desired functions and operations. This section will describe the general setting procedure. For details on each individual operation, refer to Sections 2 and 3, where detailed explanations are given.

1.8.1 Menu Tree Structure

The structure of the menus used to make settings is shown in Fig. 1-9. The procedures for calling menus and making settings is described in Tables 1-2 (a) and (b) and Table 1-3.

• Operating Mode Menus

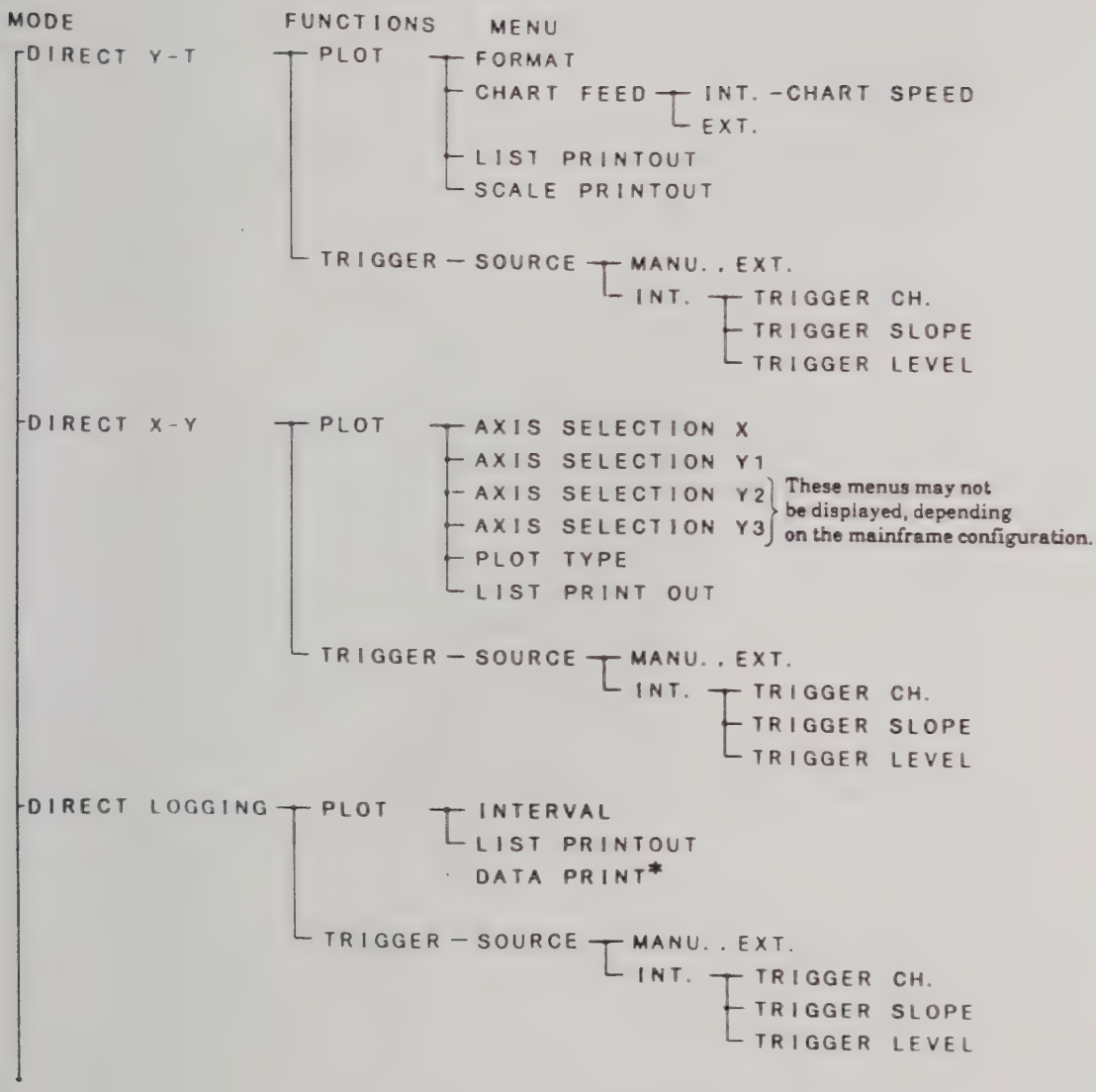
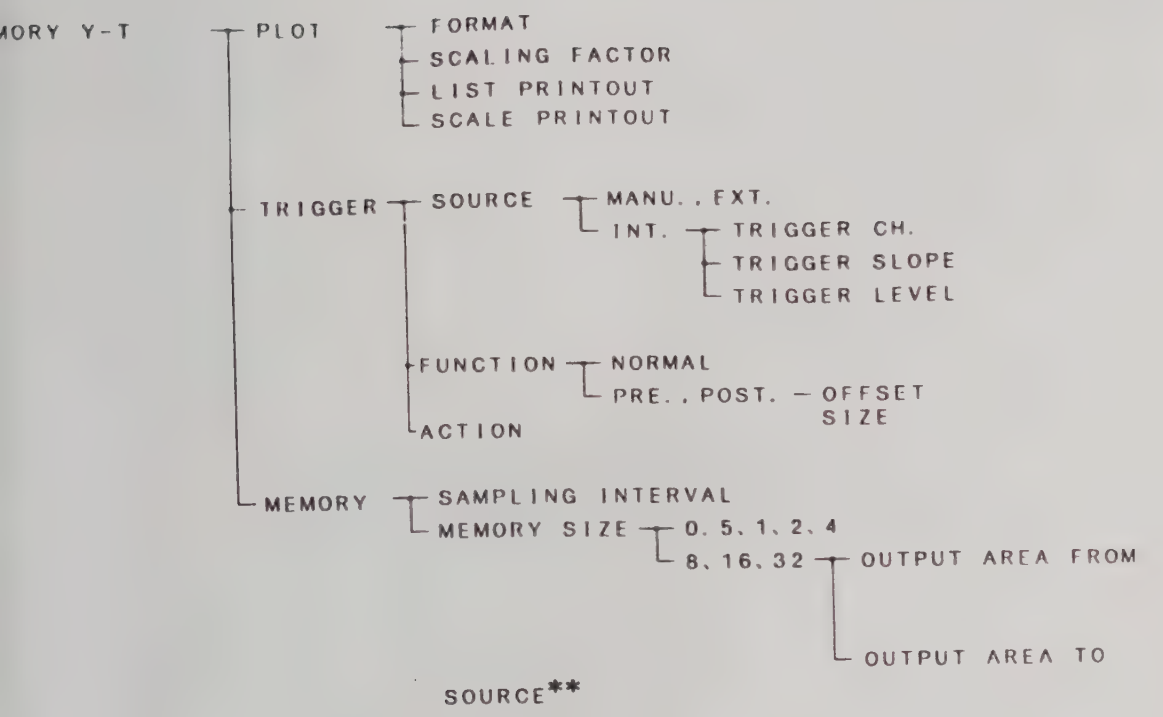


Fig. 1-9 (a)


MORY Y-T
PLOT
FORMAT
SCALING FACTOR
LIST PRINTOUT
SCALE PRINTOUT
TRIGGER
SOURCE
MANU., EXT.
INT.
TRIGGER CH.
TRIGGER SLOPE
TRIGGER LEVEL
FUNCTION
NORMAL
PRE., POST.
OFFSET
SIZE
ACTION
MEMORY
SAMPLING INTERVAL
MEMORY SIZE
0.5, 1, 2, 4
8, 16, 32
OUTPUT AREA FROM
OUTPUT AREA TO
SOURCE**

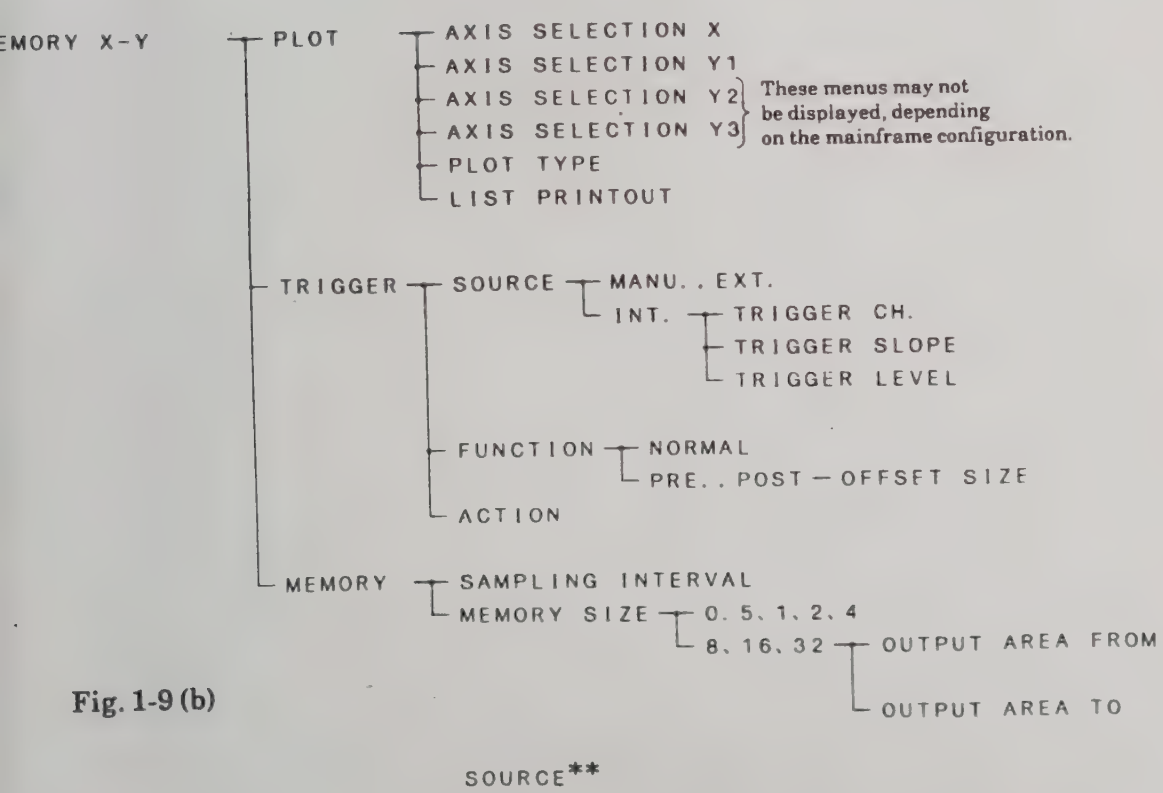

EMORY X-Y
PLOT
AXIS SELECTION X
AXIS SELECTION Y1
AXIS SELECTION Y2
AXIS SELECTION Y3
These menus may not be displayed, depending on the mainframe configuration.
PLOT TYPE
LIST PRINTOUT
TRIGGER
SOURCE
MANU., EXT.
INT.
TRIGGER CH.
TRIGGER SLOPE
TRIGGER LEVEL
FUNCTION
NORMAL
PRE., POST
OFFSET SIZE
ACTION
MEMORY
SAMPLING INTERVAL
MEMORY SIZE
0.5, 1, 2, 4
8, 16, 32
OUTPUT AREA FROM
OUTPUT AREA TO
SOURCE**

Fig. 1-9 (b)

- Menus Common to All Operating Modes

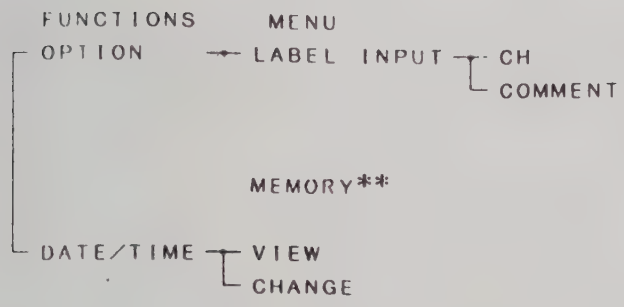


Fig. 1-9 (c)

* Displayed only when the GPIB option is installed.

** Displayed only when the backup option is installed.

2 Menu Calling Procedures

Table 1-2 (a)

Selection class	FUNCTION key	Selection using cursor up and down keys or ENTER key.	Selection using cursor left and right keys.	Remarks
	PLOT	FORMAT	[QUAD] . DUAL . SINGLE	*-1 is displayed when CHART FEED is INT.
		CHART FEED	[INT] . EXT	
		CHART SPEED *-1	[1] . 2. 5. 10. 20. 50mm/min 1. 2. 5. 10. 20. 50. 100mm/sec	
		LIST PRINTOUT	[YES] . NO	
		SCALE PRINTOUT	[YES] . NO	
	TRIGGER	SOURCE	[MANU.] . INT. . EXT	*-2 is displayed when SOURCE is INT. *-3 is invalid when the trigger channel is a logic amp.
		TRIGGER CH *-2	[1] . 2. 3. 4	
		TRIGGER SLOPE *-2. 3	[▲] . [▼]	
		TRIGGER LEVEL *-2. 3	0% ~ [50%] ~ 100 %	
	PLOT	AXIS SELECTION X	[1] . 2. 3. 4 *-4	*-4 selection items will differ depending upon the mainframe configuration. *-5 May not be displayed depending upon the mainframe configuration.
		AXIS SELECTION Y1	1. [2] . 3. 4. *-4	
		AXIS SELECTION Y2 *5	1. 2. [3] . 4. off *-4	
		AXIS SELECTION Y3 *5	1. 2. 3. [4] off *-4	
		PLOT TYPE	[LINE] . POINT	
		LIST PRINTOUT	[YES] . NO	
	TRIGGER	SOURCE	[MANU.] . INT. . EXT.	*-2 and *-3 are the same as above.
		TRIGGER CH *-2	[1] . 2. 3. 4	
		TRIGGER SLOPE *-2,3	[▲] . [▼]	
		TRIGGER LEVEL *-2,3	0% ~ [50%] ~ 100 %	
NG	PLOT	INTERVAL	[1sec] . 10sec . 1min . 10min	*-6 is displayed only when the GPIB option is installed.
		LIST PRINTOUT	[YES] . NO	
		DATA PRINT *-6	[YES] . NO	
	TRIGGER	SOURCE	[MANU.] . INT. . EXT.	*-2 and *-3 are the same as above.
		TRINGGER CH. *-2	[1] . 2. 3. 4	
		TRIGGER SLOPE *-2,3	[▲] . [▼]	
		TRIGGER LEVEL *-2,3	0% ~ [50%] ~ 100 %	
	PLOT	FORMAT	[QUAD] . DUAL . SINGLE	
		SCALING FACTOR	[1/1] . 1/2. 1/4. 1/8	
		LIST PRINTOUT	[YES] . NO	
		SCALE PRINTOUT	[YES] . NO	
	TRIGGER	SOURCE	[MANU] . INT. EXT.	*-2 and *-3 are the same as above.
		TRIGGER CH *-2	[1] . 2. 3. 4	
		TRIGGER SLOPE *-2.3	[▲] . [▼]	
		TRIGGER LEVEL *-2,3	0% ~ [50%] ~ 100 %	

Table 1-2 (b)

MODE \ Selection class	FUNCTION key	Selection using cursor up and down keys or ENTER key.	Selection using cursor left and right keys.	Remarks
MEMORY Y-T	TRIGGER	TRIGGER FUNC.	[NORMAL] , PRE., POST.	*-7 is displayed when TRIGGER FUNC. is PRE. or POST.
		OFFSET SIZE *-7	[12.5] , 25, 50, 100 %	
		TRIGGER ACTION	[SINGLE] , CONT.	
	MEMORY	SAMPLING INTVL.	[4] , 5, 10, 20, 50, 100, 200, 500 μs 1, 2, 5, 10, 20, 50, 100 , 200ms	*-8 is displayed when the memory size is 8 Kwords or greater.
		MEMORY SIZE	0.5K, 1K, 2K, 4K, 8K, 16K , [32K]	
		OUTPUT AREA *-8 FROM	[0K] , 4K, 8K, 12K , 16K , 20K , 24K 28K	
		OUTPUT AREA *-8 TO	4K, 8K, 12K , 16K , 20K , 24K 28K , [32K]	*-10 is displayed when the backup option is installed.
		SOURCE *-10	[MAIN] , BACK-UP	
MEMORY X-Y	PLOT	AXIS SELECTION X	[1] , 2, 3, 4 *-4	*-4 and *-5 are the same as on the previous page
		AXIS SELECTION Y1	1, [2] , 3, 4 *-4	
		AXIS SELECTION Y2 *5	1, 2, [3] , 4 off *-4	
		AXIS SELECTION Y3 *5	1, 2, 3, [4] off *-4	
		PLOT TYPE	[LINE] , POINT	
		LIST PRINTOUT	[YES] , NO	
	TRIGGER	SOURCE	[MANU] , , INT. , EXT.	*-2 and *-3 are the same as on the previous page. *-7 is the same as above.
		TRIGGER CH *-2	[1] , 2, 3, 4	
		TRIGGER SLOPE *-2,3	[↓] , ↑	
		TRIGGER LEVEL *-2,3	0%~ [50%] ~100 %	
		TRIGGER FUNC	[NORMAL] , PRE., POST.	
		OFFSET SIZE *-7	[12.5] , 25, 50, 100 %	
		TRIGGER ACTION	[SINGLE] , CONT.	
	MEMORY	SAMPLING INTVL.	[4] , 5, 10, 20, 50, 100, 200, 500ms 1, 2, 5, 10, 20, 50, 100 , 200 μs	*-8 and *-10 are the same as above
		MEMORY SIZE	0.5K, 1K, 2K, 4K, 8K, 16K , [32K]	
		OUTPUT AREA *-8 FROM	[0K] , 4K, 8K, 12K , 16K , 20K , 24K 28K	
		OUTPUT AREA *-8 TO	4K, 8K, 12K , 16K , 20K , 24K 28K , [32K]	
		SOURCE *-10	[MAIN] , BACK-UP	

Table 1-3 (Menus Common to All Modes)

FUNCTION key	Selection using cursor up and down keys or ENTER key.	Selection using cursor left and right keys.	Remarks
OPTION	OPTIONS *-1	[ABC] . MEMORY	*-1 is not displayed when the backup option is not installed.
	LABEL CH	[1] . 2. 3. 4	
	COMMENT	See Section 2.4.10 for details	
DATE/TIME	DATE&TIME	See Section 2.2.4 for details.	

1.8.3 Menu Setting Procedures

Settings of the various menu items are made by the following procedure while observing the LCD.

① Set the STOP key to on to stop measurement, and wait for the data or list recording to be completed.

② Select desired function from the FUNCTION key group.

③ When the LCD display indicates the menu, use the CURSOR left and right keys to select the desired item. (The flashing sections of the LCD display or selected number indicate the current value.)

④ After the setting is completed, use the CURSOR up and down keys or the ENTER key to change the display to the next (or previous) menu.

⑤ Repeat this procedure to display subsequent menus. When the settings for the function selected have been completed, the display returns to the initial menu.

⑥ Repeat ② thru ⑤ for each function.

1.8.4 Initial Settings

When the operating panel RESET key is pressed, the previous settings are all changed to the setting conditions enclosed in rectangles in Tables 1-2 (a) and (b) and Table 1-3. Performing these settings is known as initializing the settings. In addition, the internal clock will be set to January 1 1987 00:00:00.

1.9 Error Display

1.9.1 Battery Discharged Display

If the message shown in Fig. 1-10 appears when power is first applied, it indicates that either the setting condition backup or backup option battery has become discharged and that memory contents have been lost.

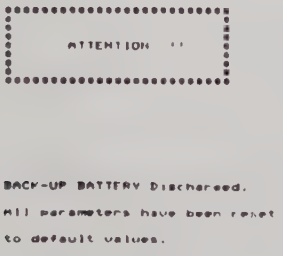


Fig. 1-10

When this message appears, all settings will have been initialized and the backup memory contents cleared.

1.9.2 Print Head Up Display

This display appears if the paper loading lever is operated during a print operation and the print head is lifted off the recording paper.

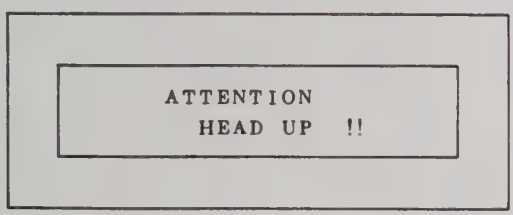


Fig. 1-11

When this display appears, recorder operation will be interrupted. When the paper loading lever is returned to its original position, the recorder will go into the STOP condition.

Appended Table 1

Interval \ Memory size	Data acquisition time						
	0.5	1	2	4	8	16	32Kwords
4 μ	2.048ms	4.096ms	8.192ms	16.380ms	32.768ms	65.536ms	131.072ms
5 μ	2.56ms	5.12ms	10.24ms	20.48ms	40.96ms	81.92ms	163.84ms
10 μ	5.12ms	10.24ms	20.48ms	40.96ms	81.92ms	163.84ms	327.68ms
20 μ	10.24ms	20.48ms	40.96ms	81.92ms	163.84ms	327.68ms	655.36ms
50 μ	25.64ms	51.2ms	102.4ms	204.8ms	409.6ms	819.2ms	1.6384s
100 μ	51.2ms	102.4ms	204.8ms	409.6ms	819.2ms	1.6384s	3.2768s
200 μ	102.4ms	204.8ms	409.6ms	819.2ms	1.6384s	3.2768s	6.5536s
500 μ	256ms	512ms	1.024s	2.048s	4.096s	8.192s	16.384s
1 m	512ms	1.024s	2.048s	4.096s	8.192s	16.384s	32.768s
2 m	1.024s	2.048s	4.096s	8.192s	16.384s	32.768s	65.536s
5 m	2.56s	5.12s	10.24s	20.48s	40.96s	81.92s	163.84s
10 m	5.12s	10.24s	20.48s	40.96s	81.92s	163.84s	327.68s
20 m	10.24s	20.48s	40.96s	81.92s	163.84s	327.68s	655.36s
50 m	25.64s	51.2s	102.4s	204.8s	409.6s	819.2s	1638.4s
100 m	51.2s	102.4s	204.8s	409.6s	819.2s	1638.4s	3276.8s
200 m	102.4s	204.8s	409.6s	819.2s	1638.4s	3276.8s	6553.6s

2. DIRECT MODE MEASUREMENT AND RECORDING

This section describes the use of the WR7600 Thermal Arraycorder as a real-time waveform recorder. It includes the installation of recording paper, power connections, processing immediately after power on and signal connection methods. It also describes the measurement and recording operations for the various operating modes within the direct mode.

2.1 Installing Recording Paper

2.1.1 Recording Paper

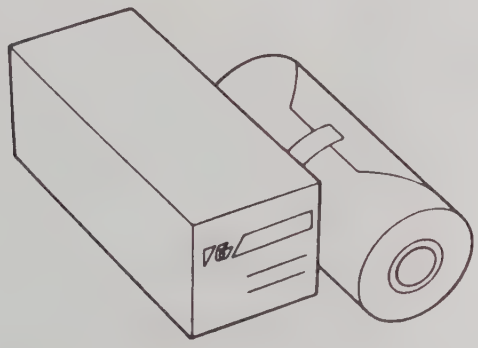


Fig. 2-1 Recording Paper

The WR7600 uses the PR-230 Thermal Recording Paper shown in Fig. 2-1. Remove the paper from its box and remove the tape holding the paper end. Next, follow the procedure below to load the paper.

2.1.2 Recording Paper Mounting Procedure (Fig. 2-2)

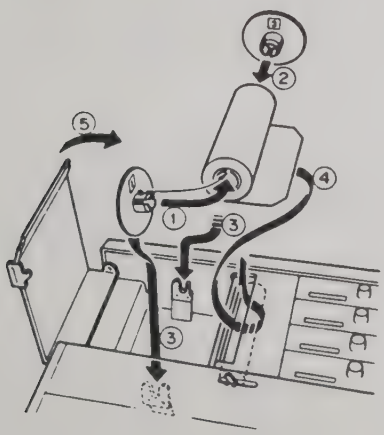


Fig. 2-2

① First, verify that the power has been switched off.

② Pull the knob protruding from the recorder panel forward to open the panel.

③ Mount the flanges [1] and [2] on the recording paper.

④ Install the recording paper into the stock section (Fig. 2-2 ③).

⑤ Set the front-panel paper loading lever to the loading position and thread the recording paper as shown in Fig. 2-3.

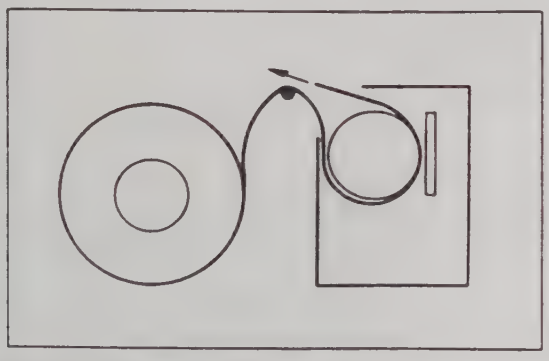


Fig. 2-3 Recording Paper and Front Flange

⑥ Pull the recording paper forward slightly, return the paper loading lever to its original position and close the recording panel.

This completes the recording paper loading procedure.

Notes

1. The last approximate 1 m of the recording paper has a red line to indicate that the end of the paper is near.
2. The thermally sensitive side of the recording paper is the side facing outward from the roll. Therefore, if the recording paper is threaded in the wrong direction, recording will not be performed.
3. If the above-described operations are attempted with the power applied to the recorder, the PAPER END LED will light and a warning message will appear on the LCD. If this occurs, switch the power off immediately.

2.2 Connecting and Applying Power

For users having the DC powered version (WR761X-XX or WR762X-XX), the Sections 2.2.1 and 2.2.2 should be replaced by Section 2.7.1 and 2.7.2.

2.2.1 Precautions

- Use only the accessory power cord with the protective ground provided (Fig. 2-5).
- When extending the above-mentioned power cord, making connections to the above power cord using the adaptor provided and in cases when a good protective ground is not connected to the power supply, always provide a separate protective ground wire at the GND terminal.
- When providing a separate protective ground, make the connection directly to the GND terminal. This connection must not be made to the input cable guard lead.
- Make absolutely certain that the VOLTAGE SELECTOR setting position matches the voltage of the AC power line to be used. If it is not, make the setting as described in Section 2.2.2.
- Extreme care is required in checking that the VOLTAGE SELECTOR is set properly, as improper setting can result in irreparable damage to the recorder.

2.2.2 VOLTAGE SELECTOR Setting

The VOLTAGE SELECTOR is set as follows.

① Set the recorder power to off.

② Insert a flatblade screwdriver into the slot at the center of the selector and set so that the desired line voltage is aligned with the ▲ printed on the panel (Fig. 2-4).

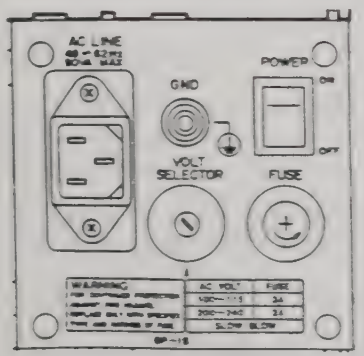


Fig. 2-4 VOLTAGE SELECTOR Setting

2.2.3 Power Cord Connection and Powering the Recorder On

After installing the recording paper and setting the VOLTAGE SELECTOR properly, connect the power cord and apply power as follows.

① Connect the female end of the accessory power cord (Fig. 2-5) to the AC line connector of the WR7600.

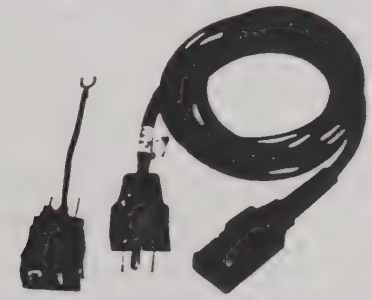


Fig. 2-5 Power Cord and Adaptor

② Connect the plug of the power cord to the AC line outlet.

③ Set the POWER switch shown in Fig. 2-4 to ON. At this point the LCD display will appear as shown in Fig. 2-6 (in the LOCAL condition).

The display shown in Fig. 2-6 indicates the initialized condition. When this display appears as a result of the above operations, it is an indication that the recorder is operating properly.

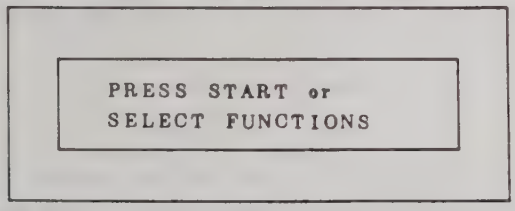


Fig. 2-6 LCD Message After Power is Applied (Local Condition)

2.2.4 Date and Time Setting Procedure

To set the date and time, the date and time setting menu is recalled and the settings made as follows.

① Press the DATE/TIME key of the FUNCTIONS key group to recall the menu (Fig. 2-7).

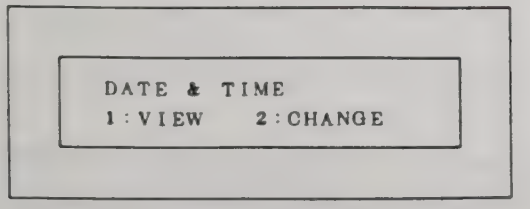


Fig. 2-7 Date and Time Setting Menu

② Press the CURSOR right key to move the cursor to the 2 (Fig. 2-8)

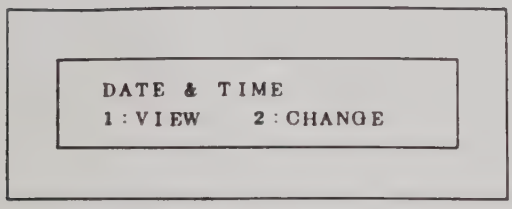


Fig. 2-8

③ Press the CURSOR down key or the ENTER key to proceed to the next setting menu (Fig. 2-9)

④ Next, press the left and right keys to move the cursor to the desired position. (If the cursor is moved to the day (01) position and then the right key is pressed, the cursor will move to the 00 hour position.)

⑤ The up and down keys can be used to increment and decrement the selected values.

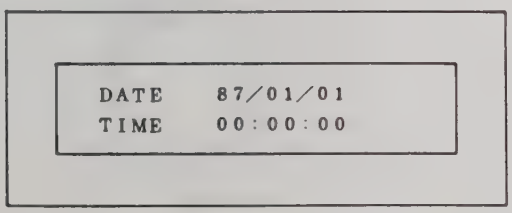


Fig. 2-9

⑥ When the desired setting value is reached, use the left and right keys to move the cursor to the next position in the same manner.

⑦ When all of the settings have been completed, wait for the actual time to reach the setting time and then press the ENTER key. This sets the internal clock and starts it running. In addition the LCD display will return to the initialized display.

2.2.5 Verification of Date and Time

① Recall the date and time setting menu as described in Section 2.2.4 ①.

② Use the CURSOR left and right keys to align the cursor with the 1 and press the CURSOR down key or the ENTER key.

③ The screen will appear as shown in Fig. 2-10, indicating the current time.

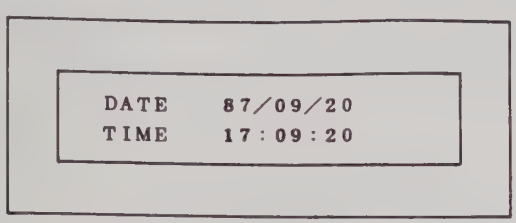


Fig. 2-10 Current Date and Time Display

④ Press the CURSOR down key or the ENTER key to return to the initialized display.

2.3 Input Signal Connections (Analog Amp Unit)

2.3.1 Input Signal Connection Method

When measuring and recording analog signals using the WR7600, in general, the RIC-01 input cable shown in Fig. 2-11 is used, following the procedure given below.

Fig. 2-11 RIC-01 Input Cable

(1) Insert the connector of the input cable into the analog input signal terminals at the rear of the recorder, observing the markings (+), (−) and G (Fig. 2-12).

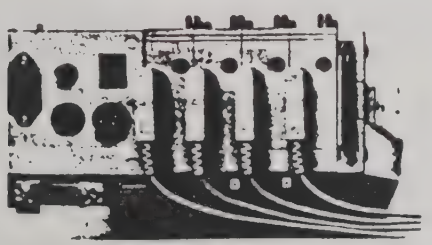


Fig. 2-12 Input Signal Cables Connected

② As shown in Fig. 2-11, the far ends of the input cables consist of a red lead, a white lead and a shield. These correspond to the (+), (−) and G pins of the connector, respectively. Solder a suitable probe (e.g., the alligator clips shown in Fig. 2-13) to the far ends.

Fig. 2-13 Aligator Clips and Pin Clips

These clips can then be used to make connection to the measurement points.

③ GND Terminal Connection

If a ground is not provided at the WR7600 case using the power cable, depending upon the signal connections, noise may be superimposed on signals. If this occurs, connect the GND terminal of the recorder using a separate lead to the signal source GND terminal (cabinet).

Notes

1. The input voltage applied between the (+) and (−) input terminals should be kept within ± 500 V (peak). The voltage between the ± input terminals and the guard terminal should not exceed 500 VDC or 170 Vrms for AC voltage.
2. In making connections to normal signal sources in which it is not necessary to connect the (−) lead to the guard terminal, the analog signal input (−) terminal and guard terminal should be connected using a shorting bar.
3. The shield lead should be connected to either the (+) or (−) signal lead at the signal source, in which case the above-mentioned shorting bar should be removed to separate the (−) terminal from the guard terminal (refer to Section 2.3.2).

2.3.2 Using the Guard Terminal

Guard is the abbreviation for guard shield and refers to the metal shielding which surrounds the entire input section of the amplifier. This metal shielding is connected to the GRD at the rear, and is insulated from the cabinet. In normal cases, a shorting bar is used to connect this to the (−) signal lead.

In such cases in which the input signal leads must pass through locations subject to the excessive induced signals, the signal lead shield can be connected at the signal source. When doing this, remove the shorting bar.

This surrounds the entire amplifier circuit with the input signal shielding lead, resulting in more effective shielding. This is an effective approach in locations subject to electrostatic and electromagnetic induction.

2.4 Using the Direct Y-T Mode

The WR7600 can be used in the direct Y-T mode as described below, enabling real-time continuous waveform recording.

2.4.1 Mode Selection

With the recorder in the STOP condition, press the MODE SELECT key until the DIRECT Y-T LED lights (Fig. 2-14).

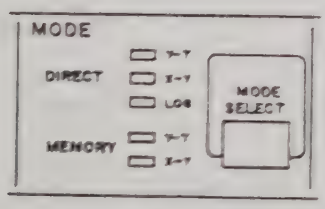


Fig. 2-14

2.4.2 Menu Settings

① Function Plot

Function plot is the name of the menu used to make recording format, chart speed and other recording settings. If the PLOT key of the FUNCTIONS group is pressed, the format menu appears on the LCD as shown in Fig. 2-15.

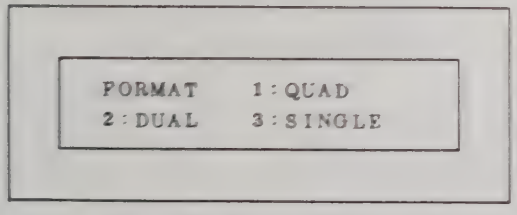


Fig. 2-15 Format Menu

② Format Setting

With the format menu displayed, press the CURSOR left and right keys to move the cursor to the number of the setting to be made. Depending upon the type of setting, the recording format will be as shown in Fig. 2-16 thru 2-18.

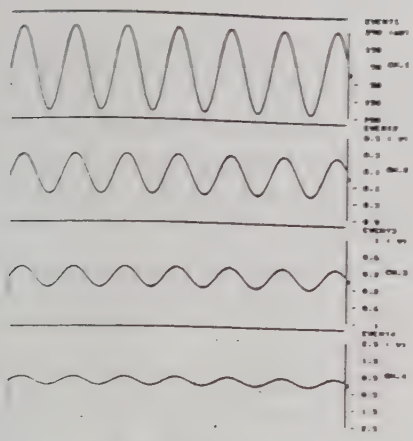


Fig. 2-16 QUAD

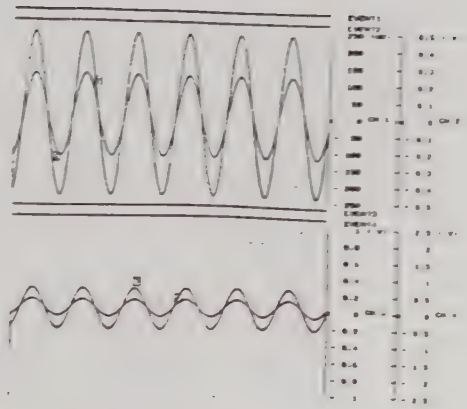


Fig. 2-17 DUAL

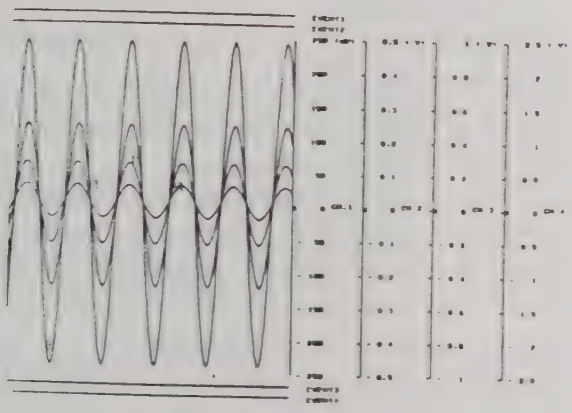


Fig. 2-18 SINGLE

(3) Chart Feed Setting

With the format menu shown in Fig. 2-15 displayed, when either the CURSOR down key or the ENTER key is pressed, the display will change to the chart feed menu (Fig. 2-19). The CURSOR left and right keys can then be used to align the cursor to the number of the the desired item. To control the recording paper feed speed by an internal setting, select "1:INT.". To select external clock control, select "2:EXT.". If "2:EXT." is selected and the down or ENTER key is pressed, the screen will change to the list printout menu shown in Fig. 2-21.

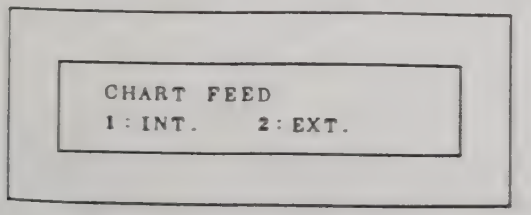


Fig. 2-19 Chart Feed Menu

④ Chart Speed Setting

If the "1:INT." setting was made from the chart feed menu and the CURSOR down or ENTER key pressed, the chart speed menu will appear as shown in Fig. 2-20. Use the left and right keys to set the desired chart speed. Note that it is also possible to change this chart speed after the start of measurements. (For details, see Section 2.4.6 (3).)

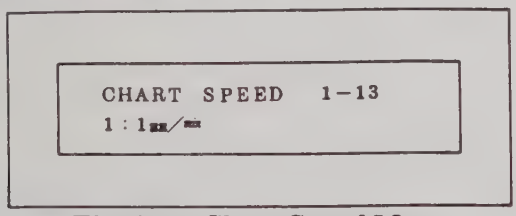


Fig. 2-20 Chart Speed Menu

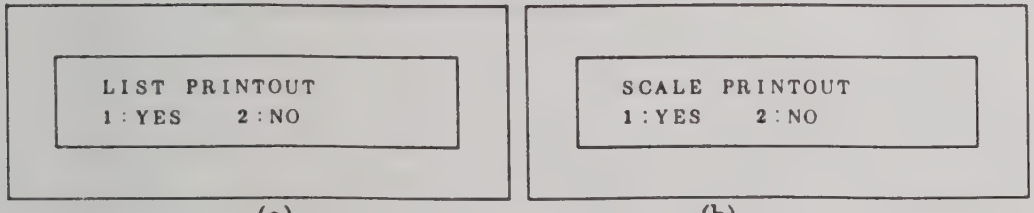
⑤ List Output Setting

With the chart speed menu displayed, if the down or ENTER key is pressed, the screen will change to the list printout menu shown in Fig. 2-21. This menu is used to establish whether or not simultaneous output of recording data and setting condition listing will be made. If 1:YES is set, recording data will be output simultaneous with the listing and if 2:NO is selected, the list will not be output.

When all the settings have been completed, press the down key or the ENTER key to return to the initialized display screen.

⑥ Scale Setting

With the list printout menu displayed, if the down or the ENTER key is pressed, the scale printout menu shown in Fig. 2-21 (b) will be displayed. This menu is used to set whether or not a scale is to be printed in the amplitude direction. Selecting 1:YES prints the scale, and selecting 2:NO inhibits printing.



(a) (b)

Fig. 2-21

⑦ Changing Menu Items

When a menu is displayed on the LCD, the CURSOR up and down keys can be used to change the menu item (with the exception of the chart speed menu) after measurement has

been started. Pressing the up key returns to the previous menu and pressing the down key proceeds to the next menu.

⑧ Function Trigger

Function trigger is the overall name of the menu used for trigger settings. If the TRIGGER key of the FUNCTIONS key group is pressed, the trigger source menu shown in Fig. 2-22 is displayed on the LCD.

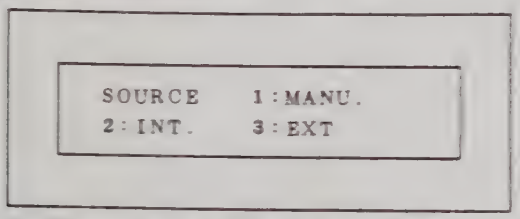


Fig. 2-22 Trigger Source Menu

⑨ Trigger Source Setting

With the trigger source menu displayed, use the left and right keys to move the cursor to the number of the desired item.

The following trigger conditions can be set.

1: MANU. Trigger applied by means of the START key.

2: INT. Triggering is performed on the data of the specified channel of the 4 channels of amplifiers.

3: EXT Triggering occurs when the EXT. TRIG trigger signal at the remote connector is input.

After setting "1: MANU." or "3: EXT", press the down key or the ENTER key to return to the initialized display screen.

⑩ Trigger Channel Setting

If "2: INT." is set from the trigger source menu and the down or ENTER key is pressed, the screen will display the trigger channel menu as shown in Fig. 2-23.

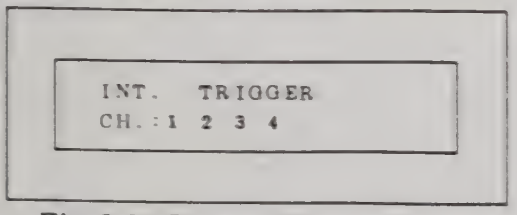


Fig. 2-23 Trigger Channel Menu

Use the left and right keys to move the cursor to the number of the channel to be used for triggering. If the trigger channel is a logic amp unit, the settings of ⑪ and ⑫ are not required, and settings conditions will be invalid.

⑪ Trigger Slope Setting

With the trigger channel menu displayed, if the down or ENTER key is pressed, the trigger slope menu will be displayed as shown in Fig. 2-24.

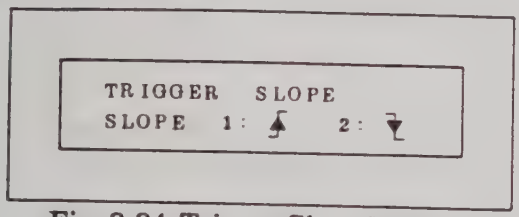


Fig. 2-24 Trigger Slope Menu

Use the left and right keys to set the trigger slope. This is set as ⌐ for rising edge and ¬ for falling edge.

⑫ Trigger Level Setting

With the trigger slope menu displayed, press the down or ENTER key to display the trigger level menu as shown in Fig. 2-25.

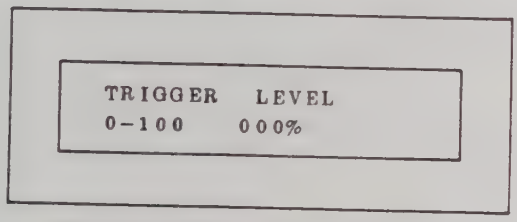


Fig. 2-25 Trigger Level Menu

Use the left and right keys to set the desired level. Pressing the left key decrements the value and pressing the right key increments the value.

When all settings have been completed, press the down or ENTER key to return to the initialized display screen.

2.4.3 Trigger Level Example

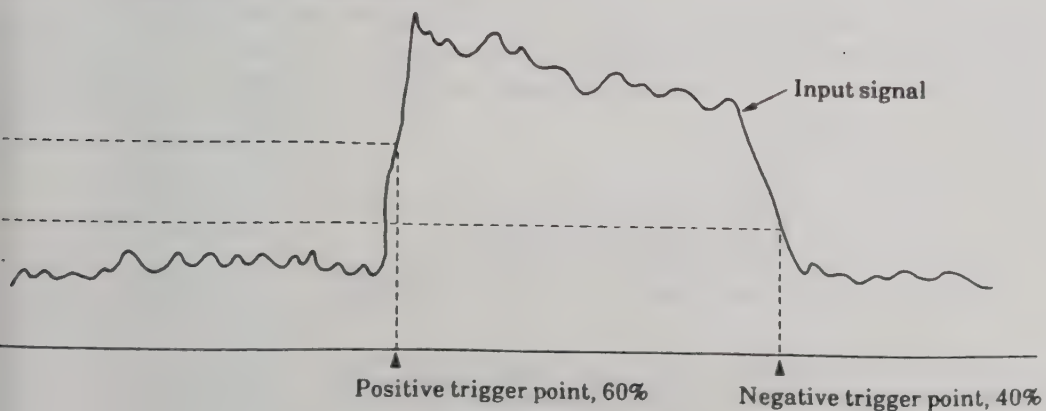


Fig. 2-26

2.4.4 Checking Menu Settings

① Checking Menu Settings Using the LCD

The LCD can be used to check menu settings by pressing the individual function keys and viewing the displayed menus in sequence, pressing the down key to move to the next menu each time.

② List Method

A list can be used to check menu settings by pressing the LIST key to output the settings in list form (as shown in Fig. 2-27).

If a change in a menu setting is required, press the function key corresponding to the related menu to recall the menu and make the change.

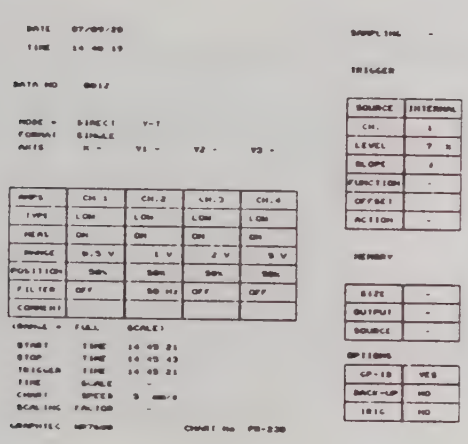


Fig. 2-27 LIST Output Example

2.4.5 Analog Amp Settings

After menu settings have been completed, set the amplifier as described in the procedure below.

① Set the MEAS. ON/OFF switch of a channel to which an input signal is connected to ON and the similar switches for amplifiers having no input signals to OFF (refer to Section ④ below).

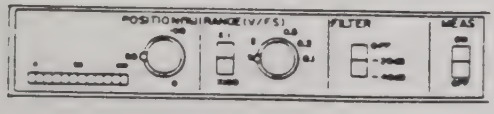


Fig. 2-28 Analog Amp Unit (L Type)

② Adjust the range and position settings of the amplifier while observing the input signal amplitude on the LED monitor. If the frequency of the input signal is high, perform recordings by following the procedure given below for the filter settings.

③ If necessary, set the filter switch (this should normally be set to OFF, however).

④ PRINT OFF

PRINT OFF refers to the inhibiting of recording of channels at which there is no data to be recorded. When the MEASURE START key is pressed, for channels having the MEAS switch set to OFF, measurement data will not be recorded. (After starting, setting MEAS. to ON does not cause restarting of recording.)

2.4.6 Verification and Corrections Before Measurements Begin

After menu and amplifier settings have been completed, actual measurement can be started. At this point, a trial recording should be made as a means of checking settings to see whether corrections are required.

① Changing the Trigger Conditions

If INT. (internal) or EXT. (external) triggering had been set, switch temporarily to MANU. (manual triggering). (This is because recording will not actually be performed unless the trigger conditions are satisfied.)

② Recording Start

Press the MEASURE START key to start recording.

③ Changing the Recording Paper Feed Speed

When recording is started, the chart speed menu shown in Fig. 2-29 appears on the LCD. At this point, the recording paper feed speed can be adjusted for an easy-to-interpret recorded waveform. Pressing the CURSOR left key slows the recording down and pressing the CURSOR right key speeds it up. When these changes are made, the menu setting display will track them automatically.

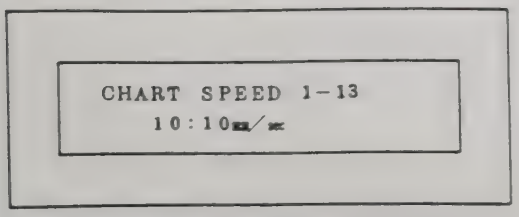


Fig. 2-29 Chart Speed Corrections

④ Amplifier Range and Position Corrections

Next, adjust the amplifier range and position settings while observing the amplitude of the recorded waveform.

⑤ Stopping Recording

After obtaining an easy-to-read recorded waveform using the procedures described in steps ① thru ④, press the MEASURE STOP key to stop recording.

⑥ Menu Corrections

Steps ① thru ④ complete settings of recording paper feed speed and amplifier range and other settings. If the recording format requires changing, recall the format menu and make the corrections. Then remember to return the trigger conditions to either the INT. or EXT. as previously set.

2.4.7 Starting and Stopping Measurement (Recording)

The above-described operations complete the preparations for measurement, and actual measurement can now be started.

① Measurement Precautions

As described in Sections ③ and ④ above, it is possible to change the recording paper feed speed and amplifier ranges and other settings during the recording process. However, the record of these changes does not appear as part of the recording. Therefore, once measurements have been started, if a change in settings becomes necessary, make the changes, stop the measurement and restart (taking care to note the settings before measurement is restarted).

② Starting Measurement

When the MEASURE START key is pressed, measurement will begin. If the trigger conditions were set to INT. or EXT., the TRIGGER WAITING message will appear on the LCD and the READY LED will light (Fig. 2-30, 2-31). In the case of MANU., however, simultaneous with the start, the trigger will be applied and these messages will not appear on the display.

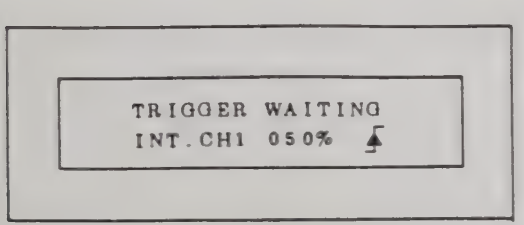


Fig. 2-30 TRIGGER WAITING Message (INT. Triggering)

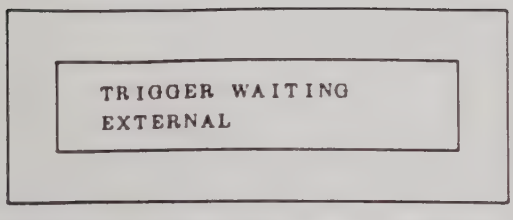


Fig. 2-31 TRIGGER WAITING Message (EXT. Triggering)

③ Starting Recording

If the trigger conditions were set to MANU., or the actual trigger signal is input and the trigger is applied, recording will start and the RECORD LED will light. The LCD display will indicate the CHART SPEED menu as shown in Fig. 2-32.

④ Stopping Measurement (Recording)

To stop measurement (recording), press the MEASURE STOP key. When the key is pressed, the measurement will be stopped immediately and, after required post-processing functions such as list output are performed, the LCD will return to the initialized display screen, the RECORD LED will be extinguished and the recorder will go into the STOP condition.

2.4.8 Direct Y-T Mode Recording

Fig. 2-32 shows the result of recording a 1.2-Hz sinewave signal using the SINGLE format. It was made by applying the same signal to each channel, with different range settings for each amplifier.

① The numbers 1, 2, 3 and 4 recorded next to the waveforms indicate the corresponding channel number. (These are not recorded in the QUAD format. They are also not printed for channels at which a logic amp is installed and when the PRINT-OFF condition has been set.)

② The scales at the right edge of the recording enable reading of data for each channel. Recording is made of the range value divided by 10 or 5 and the channel number. The logic signal number is recorded in the case of channels having logic amps installed.

③ The ◀ recorded in the middle of the scales are position marks. These indicate the amp zero positions.

④ This indicates the event signal waveform and event signal channel.

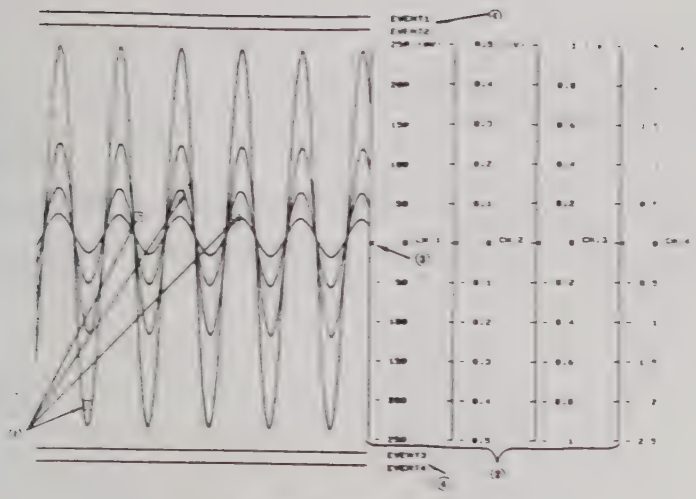


Fig. 2-32

2.4.9 Direct Y-T Mode Listing

Fig. 2-33 shows a listing output example for the recording of Fig. 2-32.

① DATE: This is the recording of the date.

② TIME: This is the recording of the time in terms of a 24-hour clock.

③ DATA No: The data number range is 0 to 9999 and this wraps around when 9999 is exceeded.

④ MODE: This indicates the operating mode.

⑤ FORMAT: This indicates the recording format.

⑥ AMPS: This is a recording of the setting conditions of the amp units installed in the recorder mainframe. It indicates the setting conditions of the amplifiers when recording is stopped.

⑦ START TIME: This indicates the time that the measurement is started.

⑧ STOP TIME: This indicates the time that measurement is stopped.

⑨ TRIGGER TIME: This indicates the time that the trigger occurs.

⑩ CHART SPEED: This is a recording paper feed speed. It indicates the recording speed set when the measurement was stopped.

⑪ TRIGGER: Recording of the trigger conditions.

⑫ COMMENT: Recording of comments for each channel.

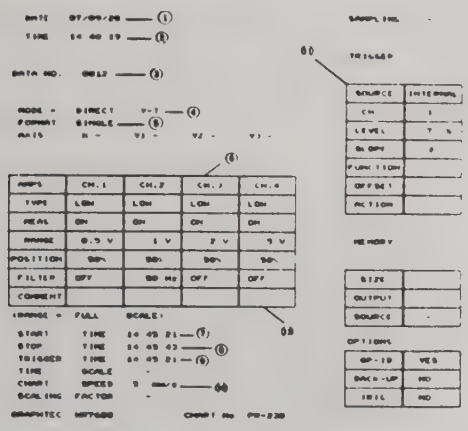


Fig. 2-33

2.4.10 Label Menu

To recall the label menu used to record comments for each channel, press the OPTION key of the FUNCTIONS key group.

① Recalling the Label Menu

For standard recorders without the backup option installed, when the OPTION key is pressed, the label menu shown in Fig. 2-35 will be immediately displayed on the LCD. For recorders in which the backup option is installed, the option menu shown in Fig. 2-34 is displayed. At this point, use the CURSOR left and right keys to move the cursor to "1" and then press the down key or the ENTER key to proceed to the label menu shown in Fig. 2-35.

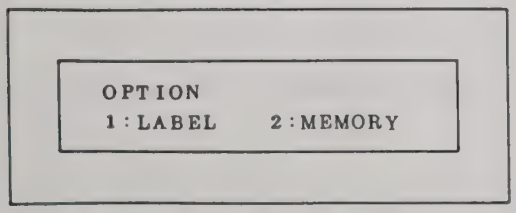


Fig. 2-34 Option Menu (With Backup Option Installed)

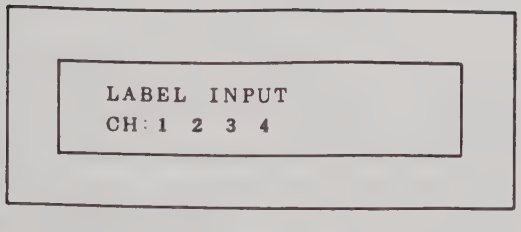


Fig. 2-35 Label Menu

② Setting the Input Channel for the Label

With the label input menu shown in Fig. 2-35 displayed, set the channel for which the comment is to be input. Use the CURSOR left and right keys to move the cursor to the channel number to be input.

③ Inputting the Comment

With the label menu displayed, press the down key or the ENTER key to proceed to the comment menu shown in Fig. 2-36. Use the CURSOR left and right keys to move the cursor to the character to be input and then press ENTER to input the character. At this point, the input character will appear at the right of the space after "COMMENT:" on the top line of the display. The character font can be changed to lower case by pressing the OPTION key. The characters in each font that can be input are shown in Fig. 2-38.

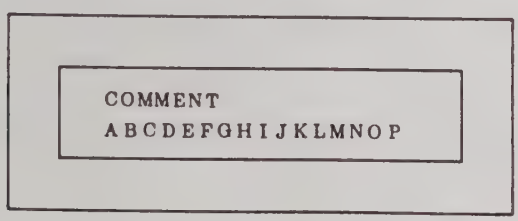


Fig. 2-36 Comment Menu (Initialized Condition)

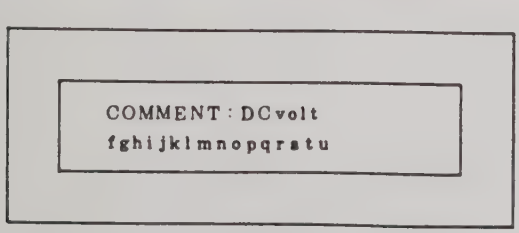


Fig. 2-37 Comment Menu (During Comment Input)

④ Deleting Input Characters

To delete characters that have been input, a deletion function is used. Recall a font using the OPTION key and use the CURSOR left and right keys to align the cursor with "DEL" and then press the ENTER key to delete the very last character that was input. There is no function provided to delete all of the characters or a selected part of the characters.

⑤ Terminating Input

To terminate the input of a comment, recall font (6) and align the cursor with END and then press the ENTER key. This will cause the comment just input to be set at the selected channel. The LCD display will return to the initialized condition. To make inputs on the other channels, repeat steps ① thru ⑤.

Font 1	ABCDEFGHIJKLMNOPQRSTUVWXYZ
Font 2	abcdefghijklmnopqrstuvwxyz
Font 3	αaβεμδ qf ¹ j ×d nopqθ∞ΩuΣπxy
Font 4	! #$%&´ ( )*+, -. /: ;<=>?@[¥]^_¯{|}→←÷
Font 5	0123456789
Font 6	DEL (END)

Fig. 2-38 Character Sets Usable When Inputting Comments

2.5 Using the Direct X-Y Mode

When all amp units are logic amp units, this mode cannot be used. The direct X-Y mode is used as described below to perform real-time continuous waveform capture and recording after measurement is completed.

2.5.1 Mode Selection

With the WR7600 in the STOP condition, press the MODE SELECT key until the DIRECT X-Y LED lights (Fig. 2-39).

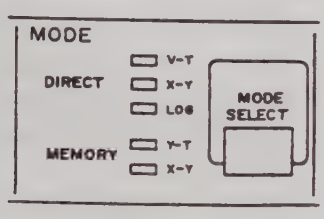


Fig. 2-39 Mode Display

2.5.2 Menu Settings

① Function Plot

Function plot is the general name for the menu used to make axis and other recording-related selections. When the PLOT key of the FUNCTIONS key group is pressed, the axis (X) menu shown in Fig. 2-40 appears on the LCD.

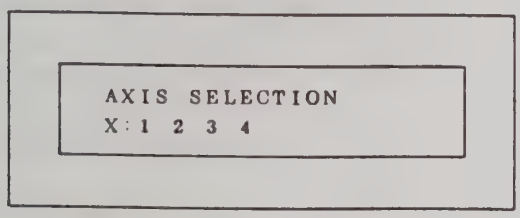


Fig. 2-40 Axis (X) Menu
(Analog Amp Units in All Channels CH1 thru CH4)

② X-Axis Setting

With the axis (X) menu displayed, use the CURSOR left and right keys to move the cursor to the channel number to be set. (The appearance of the menu and the selectable channels will depend upon the type of amplifier units installed in the recorder mainframe.)

③ Y1-Axis Setting

With the axis (X) menu displayed, press the down or ENTER key to proceed to the axis (Y1) menu shown in Fig. 2-41. As was done in step ②, move the cursor to the number of the channel to be set.

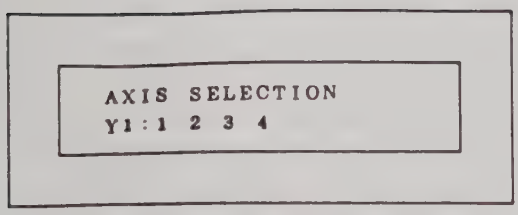


Fig. 2-41 Axis (Y1) Menu

④ Y2 and Y3 Axis Settings

As was done in step ③, set the Y2 and Y3 channels. In this menu, the "off" setting is also possible. When recording on 1 or 2 channels, the channel not required for recording can be set to "off" to inhibit recording (Fig. 2-42).

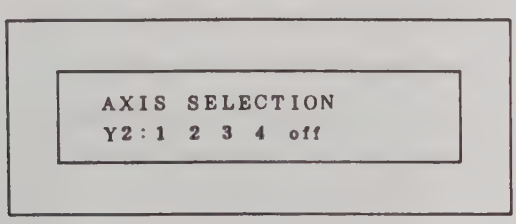


Fig. 2-42 Axis (Y2) Menu

⑤ Plot Type Menu

With the axis menu displayed, when the down key or ENTER key is pressed, the display changes to the plot type menu shown in Fig. 2-43. Use the CURSOR left and right keys to select either line plotting or point plotting by moving the cursor to the 1 or 2, respectively. For point recording the following characters are recorded.

X-Y1: ·

X-Y2: ×

X-Y3: □

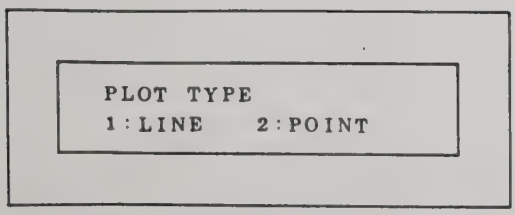


Fig. 2-43 Plot Type Menu

⑥ List Output Setting

With the plot type menu displayed, when the down or ENTER key is pressed, the display changes to the list output menu shown in Fig. 2-44. This menu is used to establish whether or not the listing of setting conditions is to be output simultaneously with the recorded data. Selecting the 1 or 2 responds with a YES or a NO to the questions of whether the list is to be printed out. When all settings are completed, press the down or ENTER key to return to the initialized display.

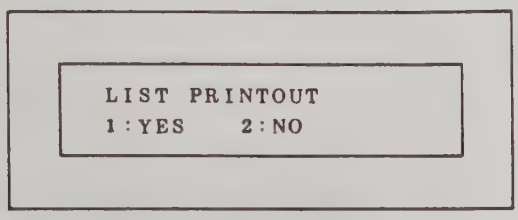


Fig. 2-44 List Output Menu

Since items after this are the same as described for direct Y-T mode recording, refer to Sections 2.4.2 ⑥ thru ⑪ and Sections 2.4.3, 2.4.4 and 2.4.5. Refer to Section 2.4.10 for the label menu.

2.5.3 Verifications and Corrections Before Starting Measurement

This section is basically the same as described for the direct Y-T mode. However, it is not possible to make changes in amp settings while recording, as can be done in the direct Y-T mode.

Make verifications and corrections of settings as described below.

① Changing Trigger Conditions

If the measurement trigger conditions are set as internal or external, temporarily switch them to manual (MANU.). (This is because the actual trigger conditions may not be satisfied.)

② Starting Recording

Press the MEASURE START key to start the measurement. The RECORD LED will light and the LCD will change to the trigger input display shown in Fig. 2-45.

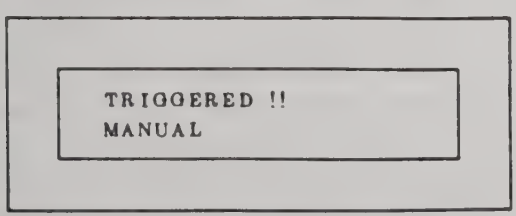


Fig. 2-45 Trigger Input Display
(With Triggering Conditions Set to MANUAL)

③ Stopping Recording

At the desired point, press the MEASURE STOP key to stop the measurement. When the measurement stops, recording will begin immediately and the LCD will display the NOW PRINTING MEASURED DATA message as shown in Fig. 2-46.

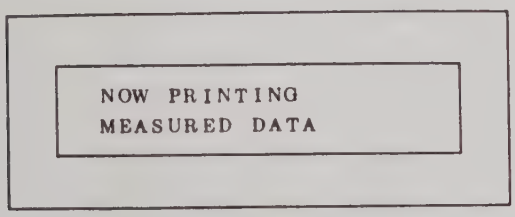


Fig. 2-46 Recording in Progress Display

④ Correcting Amplifier Settings

Examine the recorded data and, if it is necessary to change amplifier or other settings, make these corrections and then repeat steps ② thru ④ to create the desired recording.

2.5.4 Starting and Stopping Measurement (Recording)

The settings described above complete preparations for measurement. Now proceed with the actual measurement.

① Measurement Precautions (Refer to Section 2.4.7 ① & ②

② Starting Measurement

③ Starting Recording

If the triggering condition were set to MANU., or if an actual trigger signal is input, the recording will start and the RECORD LED will light. The LCD will change to the trigger input display shown in Fig. 2-45.

④ Stopping Measurement (and Starting Output of Recorded Data)

When the MEASURE STOP key is pressed, the measurement stops immediately and output of the recorded data begins. The LCD changes to the NOW PRINTING message shown in Fig. 2-46. After the output of recorded data and required post-processing of list output, the LCD returns to the initialized display, the RECORD LED is extinguished and the STOP LED is lighted as the recorder goes into the STOP condition. The DATA SAVED LED also lights at this point.

2.5.5 Direct X-Y Mode Recording

Fig. 2-47 shows an example of a line recording in the direct X-Y mode.

① The scales at the left edge and bottom edge of the recording are for reading coordinate values of the recorded data. They include markings every 1/10 of the range value, channel number and axis identification marks.

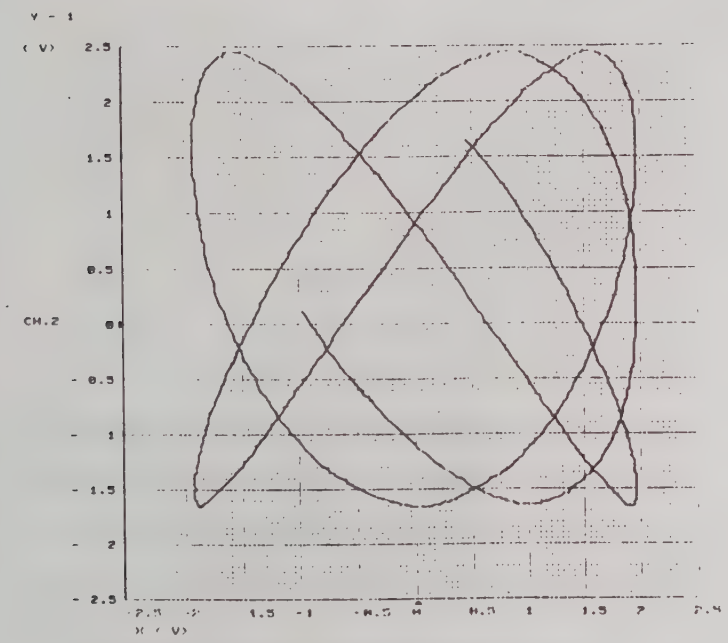


Fig. 2-47 X-Y Recording Example

② The ▸ and ▲ marks on the scales are position marks which indicate the amplifier zero position.

③ The recorded waveforms are identified as follows.

X-Y1: ·

X-Y2: ×

X-Y3: □

2.5.6 Direct X-Y Mode List Output

Fig. 2-48 shows a list output example for the recording of Fig. 2-47.

① DATE: This is the recording of the date.

② TIME: This is the recording of the time in terms of a 24-hour clock.

③ DATA No: The data number range is 0 to 9999 and this wraps around when 9999 is exceeded.

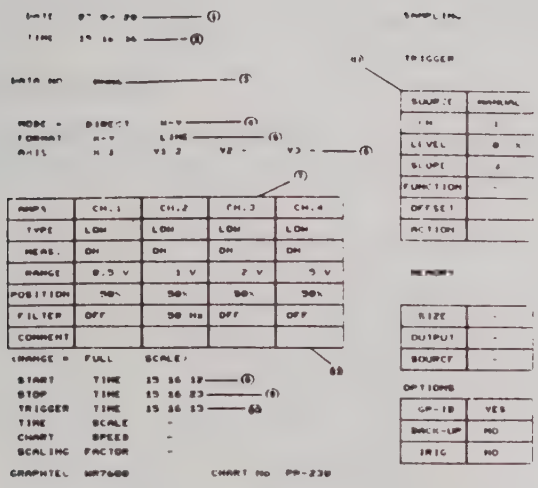


Fig. 2-48

④ MODE: This indicates the operating mode.

⑤ FORMAT: This indicates the recording format.

⑥ AXIS: This indicates the settings for the axes.

⑦ AMPS: This is a recording of the setting conditions of the amp units installed in the recorder mainframe. It indicates the setting conditions of the amplifiers when recording is stopped.

⑧ START TIME: This indicates the time that the measurement is started.

⑨ STOP TIME: This indicates the time that measurement is stopped.

⑩ TRIGGER TIME: This indicates the time that the trigger occurs.

⑪ TRIGGER: This indicates the trigger conditions.

⑫ COMMENT: Recording of comments for each channel.

2.5.7 Reprinting of Data

When measurement is stopped and output of recorded data is performed, the SAVED LED above the DATA key of the PRINT key group lights, indicating that data has been saved. In this condition, the DATA key can be pressed to output the same data once again.

2.6 Using the Direct Logging Mode

The direct logging mode can be used (as described below) to provide a list output of data values for an input signal waveform.

2.6.1 Mode Selection

With the WR7600 in the STOP condition, press the MODE SELECT key until the DIRECT LOG LED lights (Fig. 2-49).

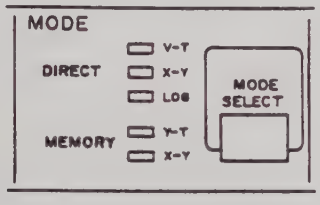


Fig. 2-49

2.6.2 Menu Settings

① Function Plot

The function plot is the general name for the menu used to set the logging interval, whether or not a list is to be output and other other recording-related settings. Press the PLOT key of the FUNCTIONS key group to call the interval menu shown in Fig. 2-50 to the LCD.

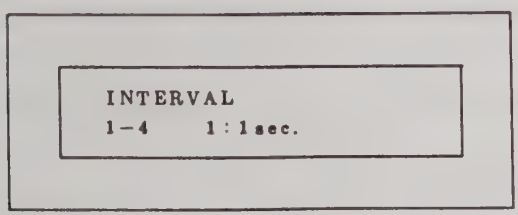


Fig. 2-50 Interval Menu

(2) Interval Setting

With the interval menu displayed on the LCD, use the CURSOR left and right keys to obtain a display of the desired interval.

③ List Output Setting

With the interval menu displayed on the LCD, if the down or ENTER key is pressed, the list output menu shown in Fig. 2-51 appears on the LCD. Input 1 (YES) to make a simultaneous listing of data with the recording and 2 (NO) to inhibit output of the data listing.

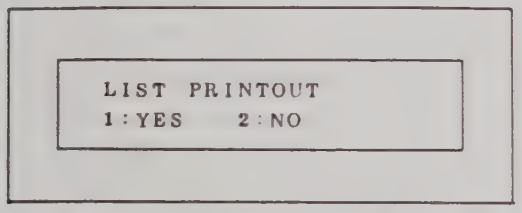


Fig. 2-51 List Output Menu

④ Data Output Setting (Only when GPIB Option is Installed)

With the list output menu displayed, if the down or ENTER key is pressed, for the standard recorder, the initialized display screen will appear and this will complete the plot function menu settings. For a recorder into which the GPIB option has been installed, the data output menu shown in Fig. 2-52 will be displayed. This menu is used to establish whether or not recorded data is to be output. If data is to be transferred via the GPIB and a recording is not required, enter 2:NO.

When the setting is completed, press the down or ENTER key to return to the original initialized display.

Since subsequent items are the same as for the direct Y-T mode, refer to Section 2.4.2 ⑥ thru ⑪ , and Sections 2.4.3, 2.4.4 and 2.4.5.

For the label menu, refer to Section 2.4.10.

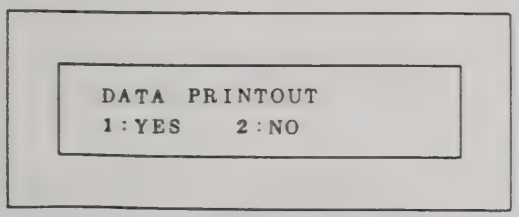


Fig. 2-52 Data Output Menu

2.6.3 Verification and Corrections Before Starting Measurement

This section is basically the same as the direct Y-T mode. However, since the measurement interval is long, it is not possible to make corrections during the recording.

In this mode, the procedure is to temporarily switch to the direct Y-T mode and make a recording to enable necessary corrections of amplifier and other settings. Then the mode can be switched back to the direct logging mode.

2.6.4 Starting and Stopping Measurement (Recording)

The above sections complete the preparations for measurement. Actual measurements can now be started.

① Measurement Preparations
② Start of Measurement

} Same as Section 2.4.7 ① and ②

When using the GPIB to transfer data to a host computer while measurements are being performed, if the range or other amplifier setting is changed during the measurement, the transferred data will lose its significance. Care should be taken that this is not allowed to occur.

③ Starting Recording

If the trigger conditions have been set to manual (MANU.) or an actual trigger signal is input, recording will start, and the RECORD LED will light. The LCD will change to the trigger input display shown in Fig. 2-53. The recording section will start recording data at the specified intervals.

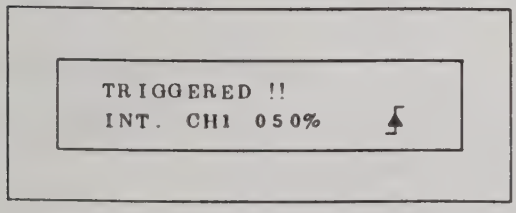


Fig. 2-53 Trigger Input Display
(With Trigger Conditions Set to INT.)

④ Stopping Measurement (Recording)

To stop the measurement (recording), press the MEASURE STOP key. When this key is pressed, measurement is stopped immediately and after the list output and other required post-processing, the LCD returns to the initialized display, the RECORD LED is extinguished and the recorder goes into the STOP condition.

2.6.5 Direct Logging Mode Recording

Fig. 2-54 shows an example of direct logging recording. In this example, a logic amp unit is installed in CH1 and analog amp units are installed in CH2 and CH3.

① Date recording: (Last 2 digits of year)/month/day

② Time recording: Hour: minute: second (24-clock)

③ Channel numbers: 1 thru 4

④ Logic amp unit recording: "1" for high and "0" for low level is recorded starting with channel 8 at the left and proceeding to channel 1.

⑤ PRINT OFF recording: "OFF" is recorded for channels set to PRINT OFF.

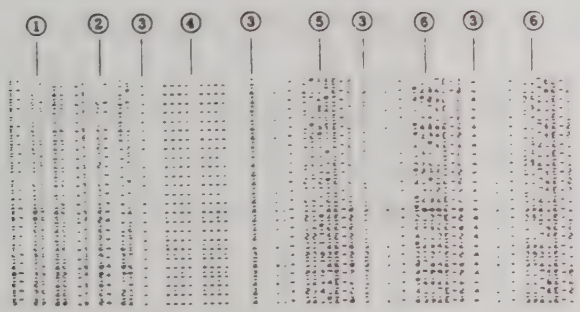
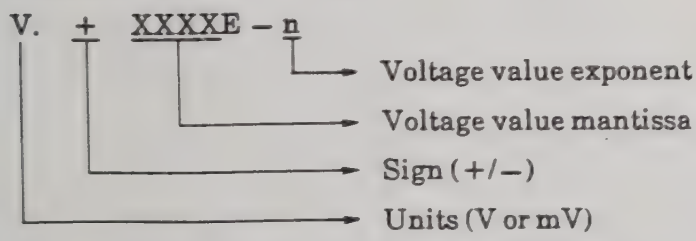


Fig. 2-54 Logging Mode Recording Example

⑥ Analog Voltage Recording



The recorded data value is in the following format.

$+XXXX \times 10^{-n}$ (V)

2.6.6 Direct Logging Mode List Output

Fig. 2-55 shows the list output of the recording shown in Fig. 2-54.

① DATE: This is the recording of the date.

② TIME: This is the recording of the time in terms of a 24-hour clock.

③ DATA No: The data number range is 0 to 9999 and this wraps around when 9999 is exceeded.

④ MODE: This indicates the operating mode.

⑤ AMPS: This is a recording of the setting conditions of the amp units installed in the recorder mainframe. It indicates the setting conditions of the amplifiers when recording is stopped.

⑥ START TIME: This indicates the time that the measurement is started.

⑦ STOP TIME: This indicates the time that measurement is stopped.

⑧ TRIGGER TIME: This indicates the time that the trigger occurs.

⑨ SAMPLING: Sampling interval recording.

⑩ TRIGGER: This indicates the trigger conditions.

⑪ COMMENT: Recording of comments for each channel.

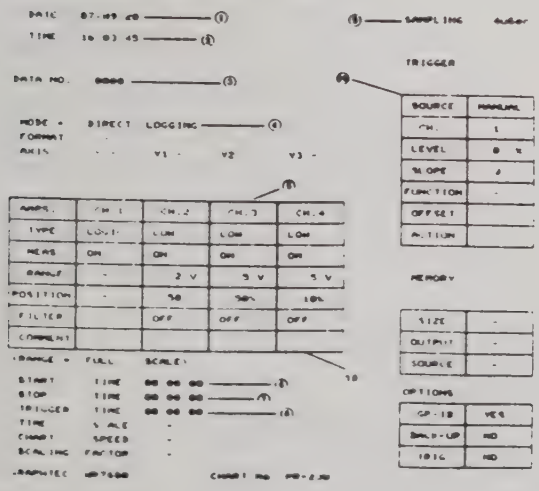


Fig. 2-55 List Output Example

2.7 Connecting and Applying DC Power

2.7.1 Connection Precautions

Caution

- Use only the accessory power cord provided with the WR7600.
- When extending the above-mentioned power cord, or repairing damage, be sure to use a cable with a current capacity of at least 15 A.
- If the input power supply voltage does not agree with the power supply voltage of the recorder, irreparable damage can occur. Check carefully before applying power to see that the following conditions are observed.

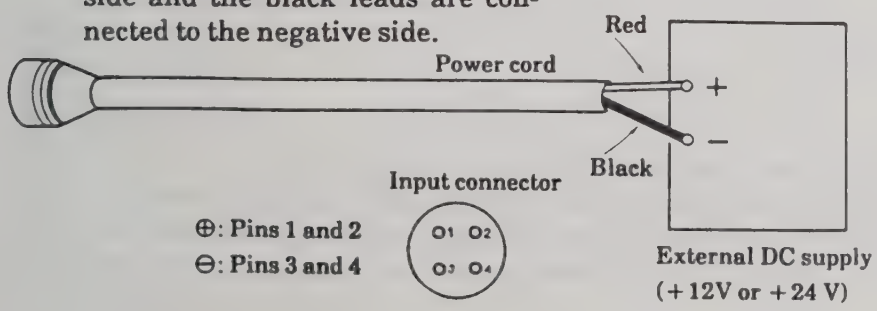
  12 VDC: Line voltage in the range 11 to 17 V
  24 VDC: Line voltage in the range 21 to 35 V

2.7.2 Power Cord Connections and Applying Power

After the recording paper is mounted, follow the procedure below to mount the power cable and apply power.

① Connect the accessory power cable connector to the power connector on the recorder so that it clicks into place securely.

② Connect the far end of the power cord to the external DC power supply. Make sure that the red leads are connected to the positive side and the black leads are connected to the negative side.



③ Set the POWER switch to ON. The LCD will light and the display will appear as shown in Fig. 2-6 (LOCAL mode). This is the initial display. If the above operations result in this display, the recorder has begun operating properly.

3. MEMORY MODE MEASUREMENT AND RECORDING

This section will describe how the WR7600's functions can be set to measure and record waveforms in the memory mode. In this mode, data is captured and stored at a set sampling interval and, when the specified memory size is filled, the data capture is stopped and recording is performed. This approach makes it possible to sample and record high-speed data and capture data when the trigger conditions are satisfied, without the speed-robbing influence of the recorder's response. This section will focus on the operational differences of this mode with respect to the direct mode.

3.1 Memory Mode Preparations

Preparations for memory mode measurement and recording are the same as for the direct mode. Refer to the descriptions given in Sections 2.1 thru 2.4 for installing paper, connecting and applying power, setting the date and time and making signal connections.

3.2 Using the Memory Y-T Mode

The WR7600 can be used in the memory Y-T mode as described below in performing high-speed waveform recording.

3.2.1 Mode Selection

With the recorder in the STOP condition, press the MODE SELECT key until the MEMORY Y-T LED lights (Fig. 3-1).

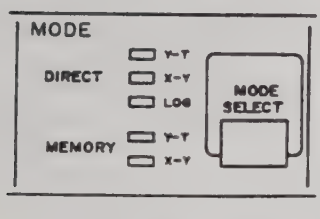


Fig. 3-1 Mode Selection

3.2.2 Memory Setting

① Function Plot

Function plot is the general name for the menu used to make recording format scaling factor settings and other recording-related settings. When the PLOT key of the FUNCTIONS key group is pressed, the format menu shown in Fig. 3-2 is displayed on the LCD.

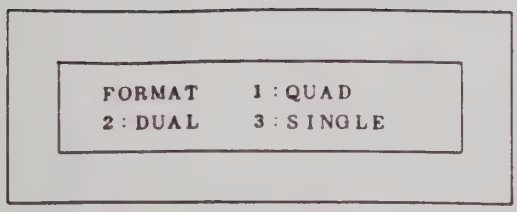


Fig. 3-2 Format Menu

② Format Setting

The format setting is made in the same manner as described for the direct Y-T mode. Refer to Section 2.4.2 ② to make this setting.

③ Scaling Factor Setting

With the format menu displayed, if the CURSOR down or ENTER key is pressed, the scaling factor menu shown in Fig. 3-3 will be displayed. This menu is used to set the amount of recording compression used when recording data. For example, if a scaling factor of 1/8 is set, the recording is compressed to a length of 1/8 for output, enabling an overall view of data trends. Table 3-1 shows the relationship between memory size, scaling factor and the recorded length. Use the left and right keys to select the desired scaling factor.

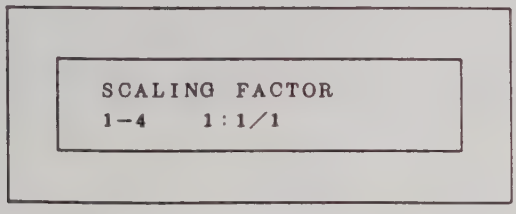


Fig. 3-3 Scaling Factor Menu

Table 3-1

*2 \ *1	Recording length (mm)			
	1/1	1/2	1/4	1/8
0.5K	85.3	42.6	21.3	10.6
1K	170.6	85.3	42.6	21.3
2K	341.3	170.6	85.3	42.6
4K	682.6	341.3	170.6	85.3
8K	1.365.3	682.6	341.3	170.6
16K	2.730.6	1.365.3	682.6	341.3
32K	5.461.3	2.730.6	1.365.3	682.6

*1: Scaling factor
*2: Memory size

④ List Output Setting

With the scaling factor menu displayed, if the down or ENTER key is pressed, the list output menu is displayed. This menu is also the same as for the direct Y-T mode. Refer to Section 2.4.2 ⑤ to make this setting. After all settings have been completed, press the down or ENTER key to return the LCD to the initialized display screen.

⑤ Function Trigger

Function trigger is the general name for the menu used to make trigger settings. When the TRIGGER key of the FUNCTIONS key group is pressed, the trigger source menu shown in Fig. 2-22 is displayed on the LCD.

The selection of the trigger source, trigger channel, trigger slope and trigger level from the function trigger menu is performed in the same manner as described for the direct Y-T mode. Refer to Sections 2.4.2 ⑧ thru ⑫ to make these settings.

⑥ Trigger Function

If any other setting besides "2:INT." is made in the trigger source menu, or if the trigger level menu is being displayed when the down or ENTER key is pressed, the LCD will display the trigger function menu shown in Fig. 3-4. Use the left and right keys to move the cursor to the number to be set (Fig. 3-6). If "1:NORMAL" is set and the down or ENTER key pressed, the LCD display will change to the trigger action menu shown in Fig. 3-7 (see Section ⑧).

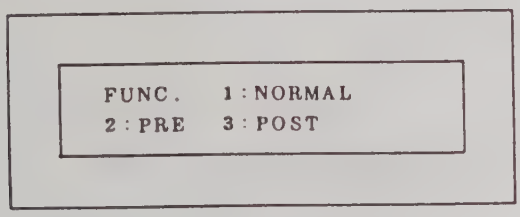


Fig. 3-4 Trigger Function Menu

⑦ Trigger Offset

If a setting other than "1:NORMAL" is set at the trigger function menu and the down or ENTER key pressed, the LCD display will change to the trigger offset display shown in Fig. 3-5.

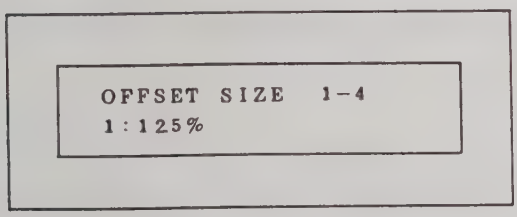


Fig. 3-5 Trigger Offset Menu

This setting enables the setting of the offset of the actual data capture with respect to the trigger signal in terms of n% of memory size (Fig. 3-6). Use the left and right keys to display the desired setting on the LCD.

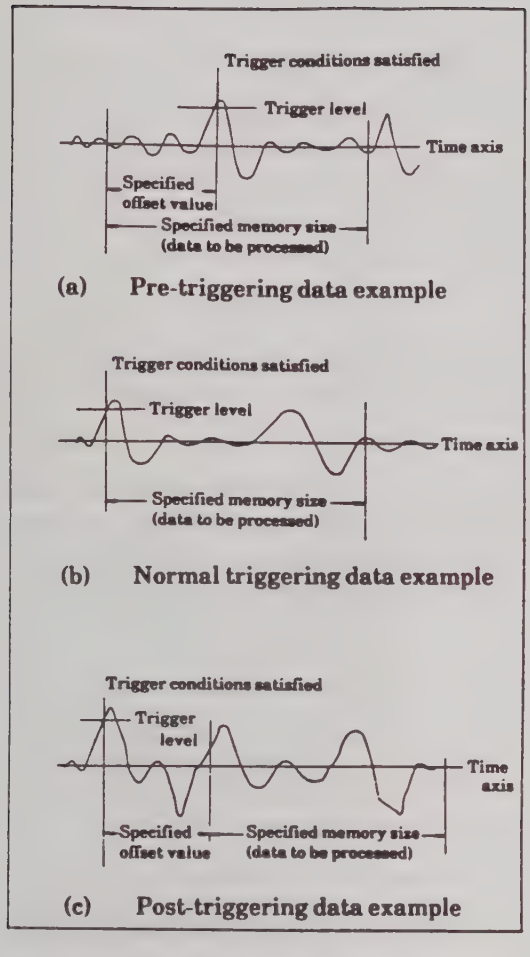


Fig. 3-6 Trigger Function Description

⑧ Trigger Action

If "1:NORMAL" is set as the trigger function or with the offset menu displayed if the down or ENTER key is pressed, the LCD will change to the trigger action menu shown in Fig. 3-7. This menu is used to establish whether one data is to be captured and recorded for each trigger signal or whether the automatic (trigger wait)→(data capture)→(record)→(trigger wait)... sequence is to be repeated. If "1:SINGLE" is selected, only one data record is measured and recorded for each trigger signal. If "2:CONT." is selected, the measurement and recording sequence is repeated until the MEASURE STOP key is pressed to actually stop the measurement.

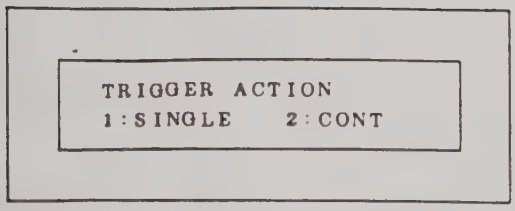


Fig. 3-7 Trigger Action Menu

When all settings have been completed, press the down or ENTER key to return the LCD to the initialized display.

⑨ Function Menu

The function menu is the general name for the menu used to make sampling interval and other memory-related settings. When the MEMORY key of the FUNCTIONS key group is pressed, the sampling interval menu shown in Fig. 3-8 is displayed on the LCD.

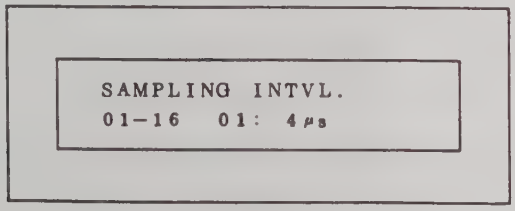


Fig. 3-8 Sampling Interval Menu

⑩ Sampling Interval Setting

This menu is used to set the sampling interval for entering data into memory. With the display shown in Fig. 3-8 on the LCD, use the CURSOR left and right keys to display the desired setting.

⑪ Memory Size Setting

With the sampling interval menu displayed, if the down or ENTER key is pressed, the LCD will proceed to the memory size menu shown in Fig. 3-9.

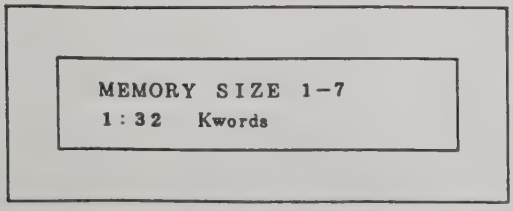


Fig. 3-9 Memory Size Menu

This menu is used to specify the capacity of memory used in data collection. Use the left and right cursor keys to select the desired capacity setting. The relationship between data recording time, memory size and the sampling interval is shown in the Appended Table 1. If the memory size is specified in the range 0.5 to 4 Kwords and the down or ENTER key is pressed, the LCD will change to the display described in Section ⑭. If any other setting is made, proceed to ⑫ below.

⑫ Output Area Setting (1)

With the memory size menu displayed, if the memory size is specified as 8 Kwords or greater and the down or ENTER key pressed, the LCD screen changes to the output area (1) shown in Fig. 3-10.

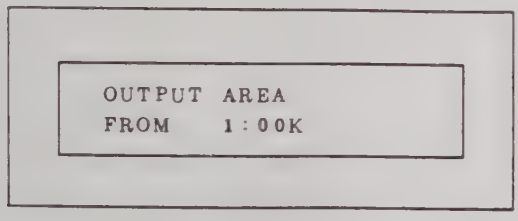


Fig. 3-10 Output Area Menu (1)

With the memory setting of 8 Kwords or greater, it is possible to specify the contents of a certain part of memory for output (in 4-Kword banks). At this menu, the setting of the first recorded output bank is made. Use the left and right keys to select the setting to be made on the LCD (this setting is made in combination with the setting described in ⑬).

⑬ Output Area Setting (2)

In the condition described in ⑫ , if the down or ENTER key is pressed, the LCD changes to the display shown in Fig. 3-11.

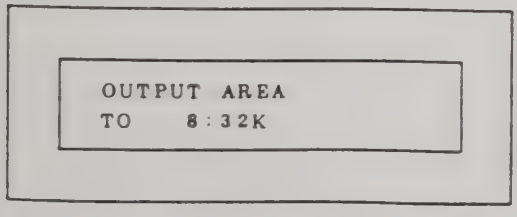


Fig. 3-11 Output Area Menu (2)

At this point, the last memory bank for recording output is specified in the same manner as described in ⑫ for the first bank. The relationship of memory size and output bank settings is shown in Fig. 3-12.

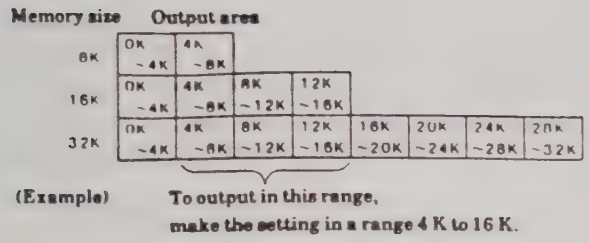


Fig. 3-12 Memory Size and Output Area Relationships

Note:

Although it is operationally possible to set a bank that is higher than the actual memory size at the menus displayed in steps ⑫and ⑬, if a selection is made that exceeds the measurement area, recording will be made for only memory banks within the measurement area.

⑭ Memory Source Setting

If the memory size menu is used to set a memory size of 4 Kwords or less or at the output area (2) menu the down or ENTER key is pressed, for the standard recorder, the LCD display will return to the initialized screen and the settings will be completed. If the backup option has been installed, however, the display will change to the memory source menu shown in Fig. 3-13.

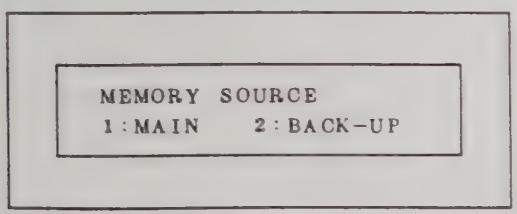


Fig. 3-13 Memory Source Menu

At this menu, the recording source data is set as MAIN (memory normally used for data collection) or BACK-UP (data archival storage memory). Use the left and right keys to select the number of the desired setting. When the setting is completed, press the down or ENTER key to return to the initialized display.

Subsequent settings are the same as for the direct Y-T mode. Refer to Sections 2.4.3, 2.4.4 and 2.4.5. For the label menu, refer to Section 2.4.10.

3.2.3 Preparations and Corrections Before Starting Measurement

When all of the above items have been set, actual measurements can be started. As a check before measurements actually begin, however, a recording should be attempted and final detailed corrections be made to amplifier settings and trigger condition settings, if required.

① Changing Trigger Conditions

Temporarily set the measurement trigger conditions to MANU. (See Section 2.4.6 ①).

② Starting Measurement (Recording)

Press the MEASURE START key to start the measurement. The LCD will display the "TRIGGERED!!" message shown in Fig. 3-14.

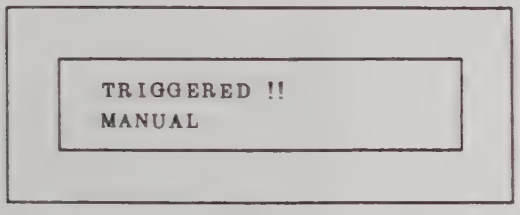


Fig. 3-14 Trigger Input Display

When the measurement is complete, recording will be started automatically and the LCD will change to the "NOW PRINTING" message shown in Fig. 3-15.

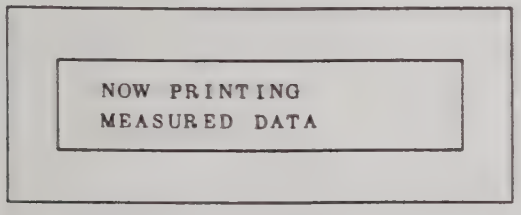


Fig. 3-15 NOW PRINTING Display

When output of recorder data is completed, the LCD will return to the initialized display.

③ Correcting Settings

Observe the output of recorded data and make necessary menu and amplifier setting corrections.

3.2.4 Starting and Stopping Measurement (Recording)

The above sections complete the preparations for measurement. Actual measurement can now be started.

① Measurement Precautions
② Starting Measurement
} Refer to Section 2.4.7 ① and ②.

③ Starting Data Collection

If the trigger condition is set to manual (MANU.) or an actual trigger signal is input, data collection will start and the RECORD LED will light. The LCD screen will appear as shown in Fig. 3-14. When the set memory size has been filled, the next recording operation will be automatically started (refer to Section ⑤).

④ Terminating a Data Collection Operation Midway

If, for some reason, it is necessary to terminate a data collection sequence, press the MEASURE STOP key. When this key is pressed, the data collection will be immediately terminated and the LCD display will return to the initialized display as the recorder switches to the STOP condition.

⑤ Starting and Stopping Data Recording

When data collection is completed, data recording begins. The LCD screen changes to the NOW PRINTING display shown in Fig. 3-15. When recording is completed, the LCD display returns to the initialized display and the recorder goes into the STOP condition. The SAVED LED above the DATA key lights, indicating that there is data in the memory.

⑥ Terminating Data Recording

If, for some reason, it is necessary to terminate data recording, press the MEASURE STOP key. When this is done, recording will stop, the LCD display will return to the initialized display and the recorder will go into the STOP condition.

3.2.5 Memory Y-T Mode Recording

Fig. 3-16 shows an example of recording in the memory Y-T mode (DUAL).

① The numbers 1, 2, 3 and 4 recorded next to the waveforms indicate the corresponding channel number. (These are not recorded in the QUAD format. They are also not printed for channels at which a logic amp is installed and when the PRINT-OFF condition has been set.)

② The scales at the right edge of the recording enable reading of data for each channel. Recording is made of the range value divided by 10 or 5 and the channel number. The logic signal number is recorded in the case of channels having logic amps installed.

③ The ▶ recorded in the middle of the scales are position marks. These indicate the amp zero positions.

④ The ◣ T at the bottom edge of each recording is the trigger mark. It indicates the trigger point. Depending upon the recording condition, if this trigger point does not exist on the recorded output, it will be indicated as ◢ or ◣, to denote the direction in which the trigger point exists (i.e. "off screen").

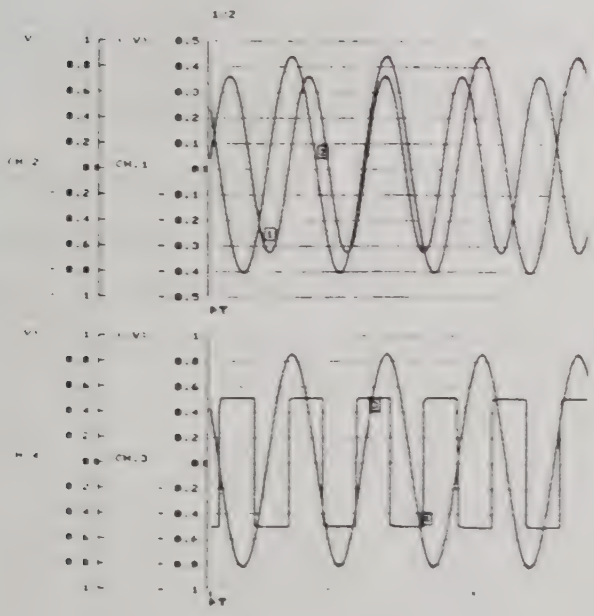


Fig. 3-16

3.2.6 Memory Y-T Mode Listing

Fig. 3-17 is a listing of the data recording shown in Fig. 3-16.

① DATE: This is the recording of the date.

② TIME: This is the recording of the time in terms of a 24-hour clock.

③ DATA No: The data number range is 0 to 9999 and this wraps around when 9999 is exceeded.

④ MODE: This indicates the operating mode.

⑤ FORMAT: This indicates the recording format.

⑥ AMPS: This is a recording of the setting conditions of the amp units installed in the recorder mainframe. It indicates the setting conditions of the amplifiers when recording is stopped.

⑦ START TIME: This indicates the time that the measurement is started.

⑧ STOP TIME: This indicates the time that measurement is stopped.

⑨ TRIGGER TIME: This indicates the time that the trigger occurs.

⑩ TIME SCALE: This is the time scale which indicates the time value per division.

⑪ SCALING FACTOR: This is the recorded data compression ratio.

⑫ SAMPLING: Recording of the sampling interval.

⑬ TRIGGER: This indicates the trigger conditions.

⑭ MEMORY: Memory condition recording.

⑮ COMMENT: Recording of comments for each channel.

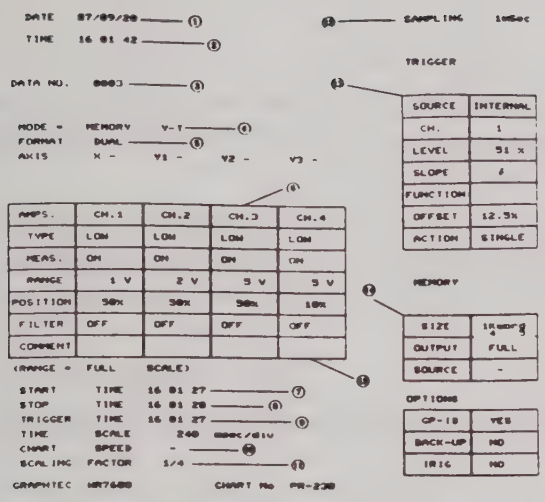


Fig. 3-17 Memory Y-T Mode List Example

3.3 Using the Memory X-Y Mode

This mode is not usable when all amp units are logic amp units.

The memory X-Y mode can be used for high-speed X-Y recording as described below.

3.3.1 Mode Selection

With the recording in the STOP condition, press the MODE SELECT key until the MEMORY X-Y LED lights (Fig. 3-18).

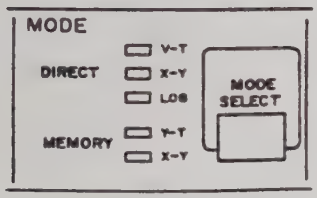


Fig. 3.18 Mode Selection

3.3.2 Menu Settings

① Function Plot

This item is exactly the same as described for the direct X-Y mode. Refer Sections 2.5.2 ① thru ⑥.

② Function Trigger

③ Function Menu

Items ② are ③ precisely the same as described for the memory Y-T mode. Refer to Sections 3.2.2 ⑤ thru ⑭.

Subsequent settings are the same as for the direct Y-T mode. Refer to Sections 2.4.3, 2.4.4 and 2.4.5. For the label menu, refer to section 2.4.10.

Verification and corrections before starting measurement and starting and stopping procedures for measurement and recording are the same as for the memory Y-T mode. Refer to Sections 3.2.3 and 3.3.4.

3.3.3 Memory X-Y Mode Recording

Fig. 3-19 shows an example of recording in the memory X-Y mode (LINE).

① The scales at the left edge and bottom of the graph are for reading data along each axis. They are marked in values of the scale value divided by 10, channel numbers and axis.

② The ▸ and ▲ marks recorded in the middle of the scales are position marks. These indicate the amp zero positions.

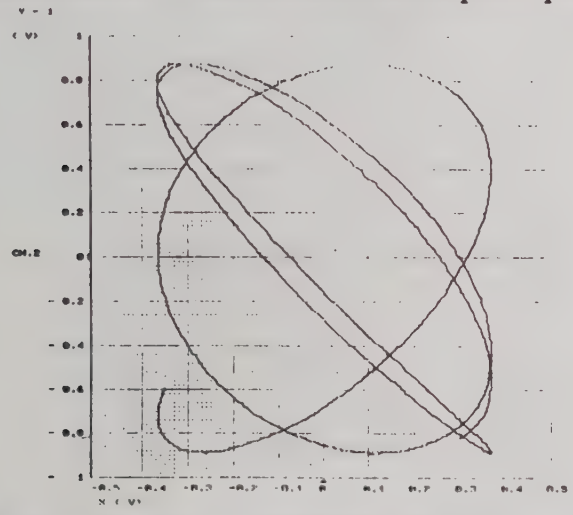


Fig. 3-19 Memory X-Y Mode Recording Example

3.3.4 Memory X-Y Mode Listing

Fig. 3-20 shows a list output example for the recording of Fig. 3-19.

① DATE: This is the recording of the date.

② TIME: This is the recording of the time in terms of a 24-hour clock.

③ DATA No: The data number range is 0 to 9999 and this wraps around when 9999 is exceeded.

④ MODE: This indicates the operating mode.

⑤ FORMAT: This indicates the recording format.

⑥ AXIS: Setting condition for each axis.

⑦ AMPS: This is a recording of the setting conditions of the amp units installed in the recorder mainframe. It indicates the setting conditions of the amplifiers when recording is stopped.

⑧ START TIME: This indicates the time that the measurement is started.

⑨ STOP TIME: This indicates the time that measurement is stopped.

⑩ TRIGGER TIME: This indicates the time that the trigger occurs.

⑪ SAMPLING: Recording of the sampling interval.

⑫ TRIGGER: This indicates the trigger conditions.

⑬ MEMORY: Memory condition recording.

⑭ COMMENT: Recording of comments for each channel.

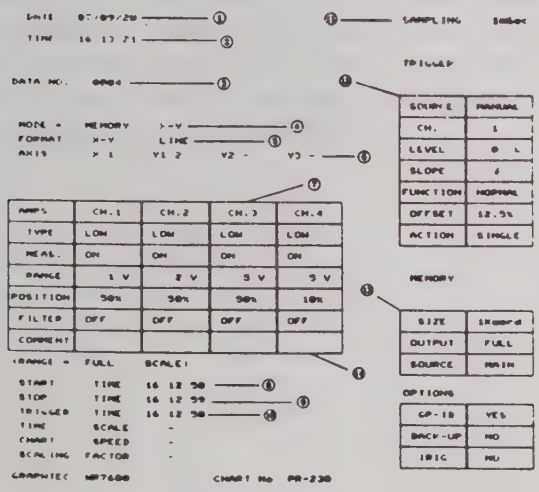


Fig. 3-20

3.4 Reprinting Data in the Memory Mode

Once data has been collected into memory, as long as the data is not updated, it is possible to create a data recording of it once again.

3.4.1 Method of Reprinting Data

To print the same data once again, press the DATA key of the FUNCTIONS key group. The same data as before will be output.

3.4.2 Changing Output Data

① Changing Memory Y-T Mode Data

For memory Y-T mode data, the format (Section 2.4.2 ②), scaling factor (Section 3.2.2 ③) and output area (Sections 3.2.2 ⑫and ⑬) menu settings can be changed before re-output of data. If the backup option has been installed, output is also possible after changing the memory source.

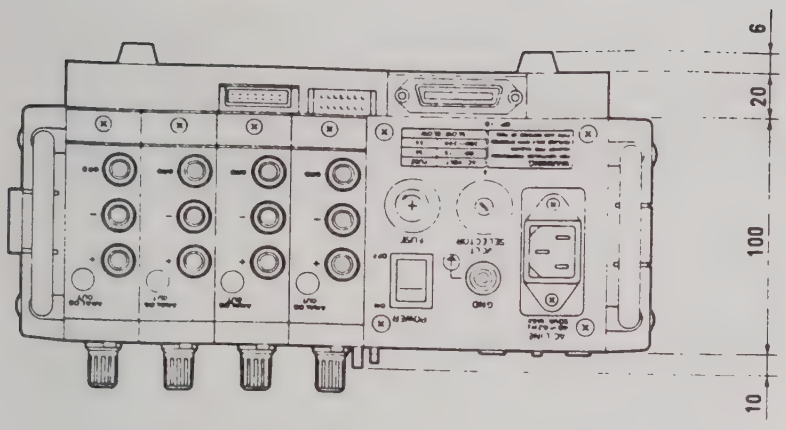
② Changing Memory X-Y Mode Data

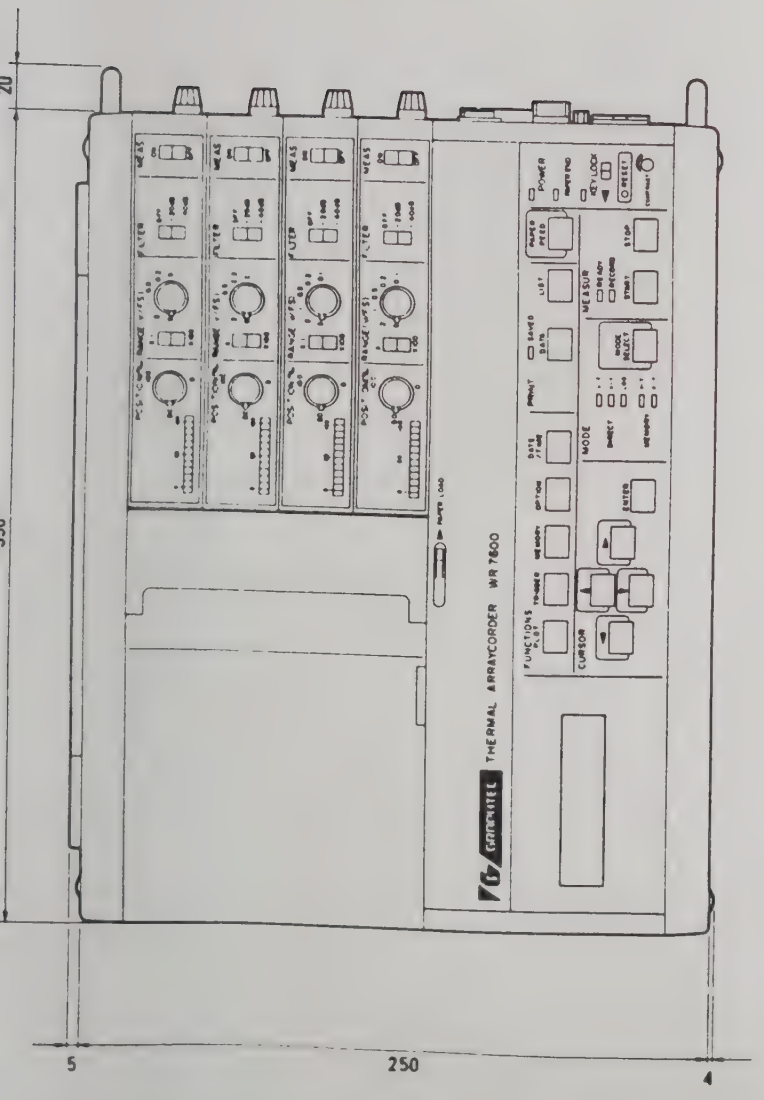
For memory X-Y mode data, the axis setting (Sections 2.5.2 ② thru ④), plot type (Section 2.5.2 ⑤) and output area (Sections 3.2.2 ⑫ and ⑬) menu settings can be changed before re-output of data. If the backup option has been installed, the memory source can also be changed before re-output.

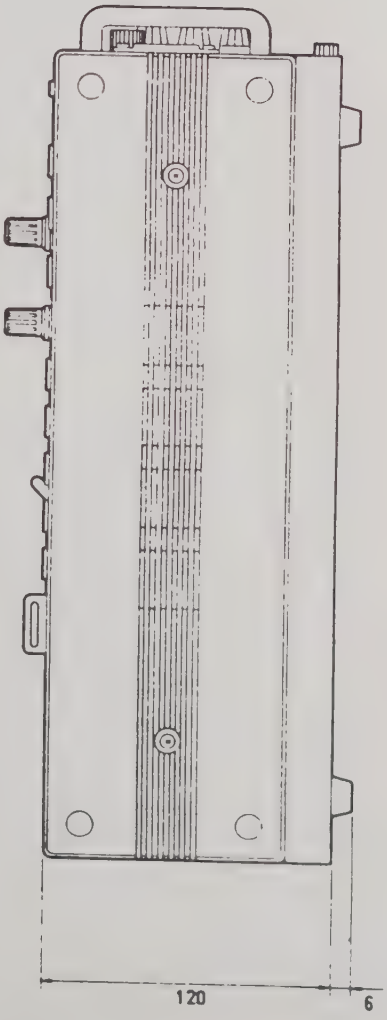
③ Changes Between Memory Y-T and X-Y Modes

It is possible to use the MODE SELECT key to change between the memory Y-T and memory X-Y modes before re-output of the recorded data. When doing this, the memory size should be adjusted to agree with the menu setting that was in effect when data was first collected. The changes that can be made are the same as described in Sections ① and ②.

4. OUTER VIEWS







INSPECTION CERTIFICATION

This product was manufactured under a strict program of quality control and has passed severe inspections. Inspections were performed at normal room temperature and humidity after the unit's circuitry was allowed to stabilize.

Inspector: _____

The specifications in this manual are subject to change without prior notice.

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Measurement Systems Division

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